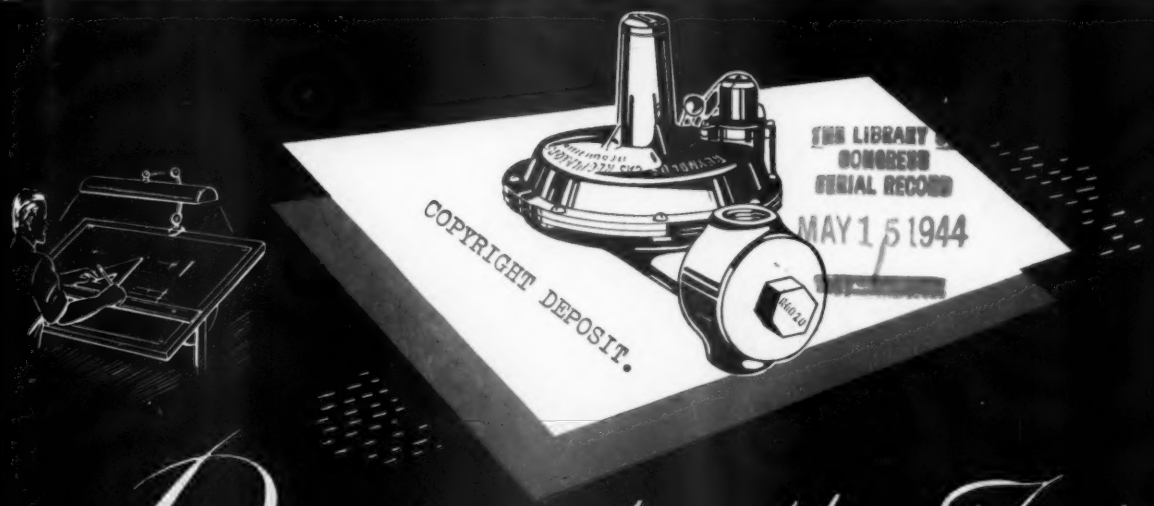
85th YEAR

AMERICAN GAS JOURNAL

MAY 1944



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Common sense dictates good meter care. Now especially, it is imperative to make old equipment last for the duration. Today's operations call for increasing vigilance on the part of those in charge of measurement. Inspect and test regularly, service carefully, and thus forestall as much as possible the need for new meters.

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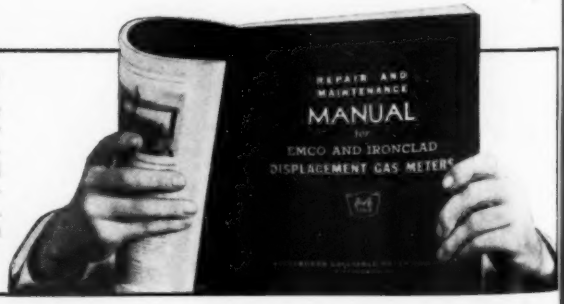
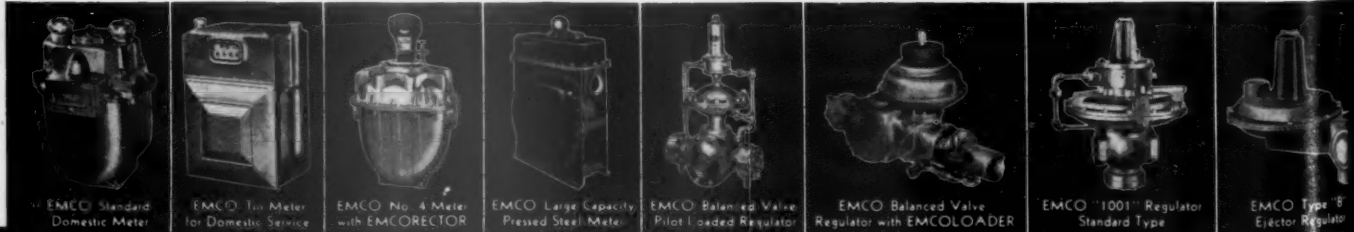
Put new life into your present EMCO Meters. This 80 page Repair and Maintenance Manual, profusely illustrated, tells by word, picture and diagram the approved factory methods for reconditioning EMCO and Ironclad displacement meters. Jigs and tools described therein can be secured that will assure an accurately fitted, free running repair job even with inexperienced labor. Your meters can be kept in top condition for the duration through the proper installation of modernized EMCO repair parts. Write for your free copy of this manual today.



EMCO METERS AND REGULATORS



EMCO Standard Domestic Meter | EMCO Tin Meter for Domestic Service | EMCO No. 4 Meter with EMCORECTOR | EMCO Large Capacity Pressed Steel Meter | EMCO Balanced Valve Pilot Loaded Regulator | EMCO Balanced Valve Regulator with EMCOLOADER | EMCO "1001" Regulator Standard Type | EMCO Type "B" Ejector Regulator

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A QUIZ PROGRAM FOR GAS PRODUCTION MEN

What do you know ABOUT CARBURETED WATER GAS MACHINES?

Q. *Can a carbureted water gas machine be operated successfully and efficiently on 100% bituminous coal and 100% heavy oil?*

A. Yes, indeed, if it is a Semet-Solvay REVERSE FLOW Water Gas Machine.

Q. *Does operation on 100% bituminous and 100% heavy oil cause the machine to smoke?*

A. No, indeed, not the Semet-Solvay REVERSE FLOW Water Gas Machine.

Q. *Can a carbureted water gas machine be changed at will, and without alterations in the machine, from coke or anthracite to bituminous coal, and from one grade of oil to another grade?*

A. Yes, indeed, if it is a Semet-Solvay REVERSE FLOW Water Gas Machine. You can take advantage of every change in market prices.

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Q. *Are all Semet-Solvay Water Gas Machines REVERSE FLOW?*

A. No, indeed. Semet-Solvay can furnish all types of water gas machines.

Q. *Are all REVERSE FLOW Water Gas Machines Semet-Solvay Machines?*

A. Yes, indeed. REVERSE FLOW is an exclusive Semet-Solvay development.

Q. *Is it difficult to make sure just what economies and other advantages you can expect from the REVERSE FLOW process in YOUR plant?*

A. No, indeed. Semet-Solvay will be glad to make a survey and complete report without cost or obligation to you. Why not write them today?

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WE SELL SOLUTIONS TO GAS PROBLEMS

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ALL THESE FEATURES

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- Excellent Insulation—Completely surrounds oven and broiler—contributes to kitchen comfort.

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Use your Stove Purchase Certificates to purchase this new gas range which bears the name Roper—a name that strikes a responsive note in the mind of every housewife. Well-built, smartly designed, it offers a complete top-of-range, broiler and oven cooking service.

GAS

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For Efficiency—
CRYSTOLON Brick

NORTON CRYSTOLON Brick are bringing real savings in time and money to operators of water gas sets. Used to line the fire zone of the generator, these densely-made brick resist the penetration of clinkers so that the set need be open only briefly for clinker removal. Major repairs, even patching, are seldom necessary with CRYSTOLON Brick which, because of their high refractoriness and great ruggedness, often give more than 22,000 hours of actual gas-making time.

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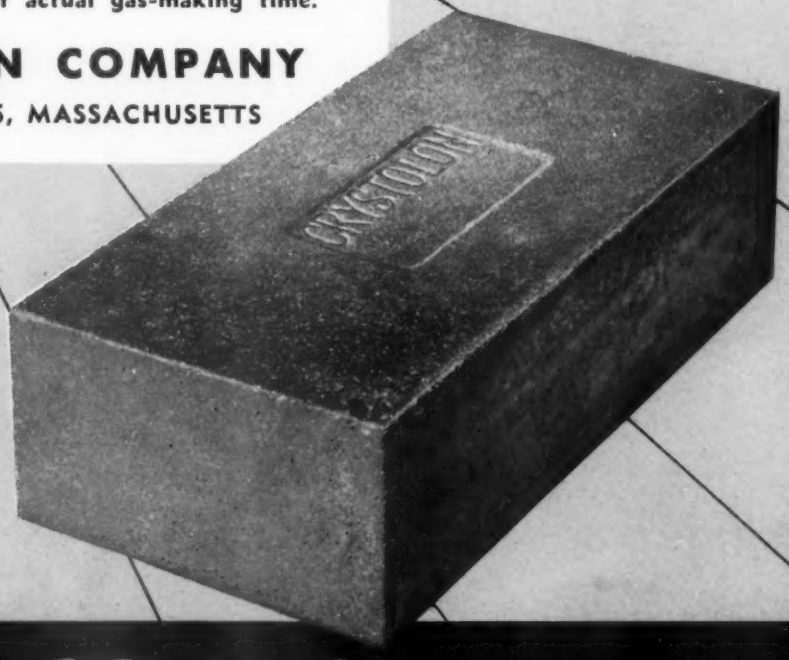

Norton Longer Lasting **Refractories**

If you NEED it now

"... and it can be installed without skilled labor."

You can GET it now

If a shipment of pipe is necessary for the maintenance of your distribution system at something like reasonable efficiency, you can get that pipe *now* if you order cast iron pipe. To meet just such situations, our members are carrying ample stocks of both mechanical joint pipe and bell-and-spigot pipe on their storage yards. In addition, the Office of War Utilities of the War Production Board, recognizing that gas is indispensable to many war industries, as well as homes, *wants* you to maintain your gas distribution system at requisite efficiency to meet existing demand.

☆ ☆ ☆

Every experienced distribution engineer knows that cast iron pipe is long-lived and economical (the first cast iron gas main laid by the first gas company in America is still in service). He also knows that cast iron pipe is available with mechanical joints, tested by the A.G.A. Laboratory, and proved in the field to be bottle-tight under high pressures. And he also knows that mechanical joint cast iron pipe can be quickly and easily installed without skilled labor.

For further information, address Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, Peoples Gas Building, Chicago 3.

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REPEAT ORDERS tell the Story

Repeat orders prove the value of Blaw-Knox Gas Cleaners. Original installations prove so successful that gas companies equip other stations as quickly as they can.

What the purchasers of Blaw-Knox Gas Cleaners think of their performance is clearly indicated by the number of repeat orders that follow initial installations. Write us today for complete illustrated data.

Gas companies buy Blaw-Knox Gas Cleaners again and again because they —

- Protect fine compressor station equipment
- Assure "availability" of compressors during peak loads
- Reduce customer complaints and service calls
- Lower pump station upkeep and transportation costs
- Help maintain better public relations

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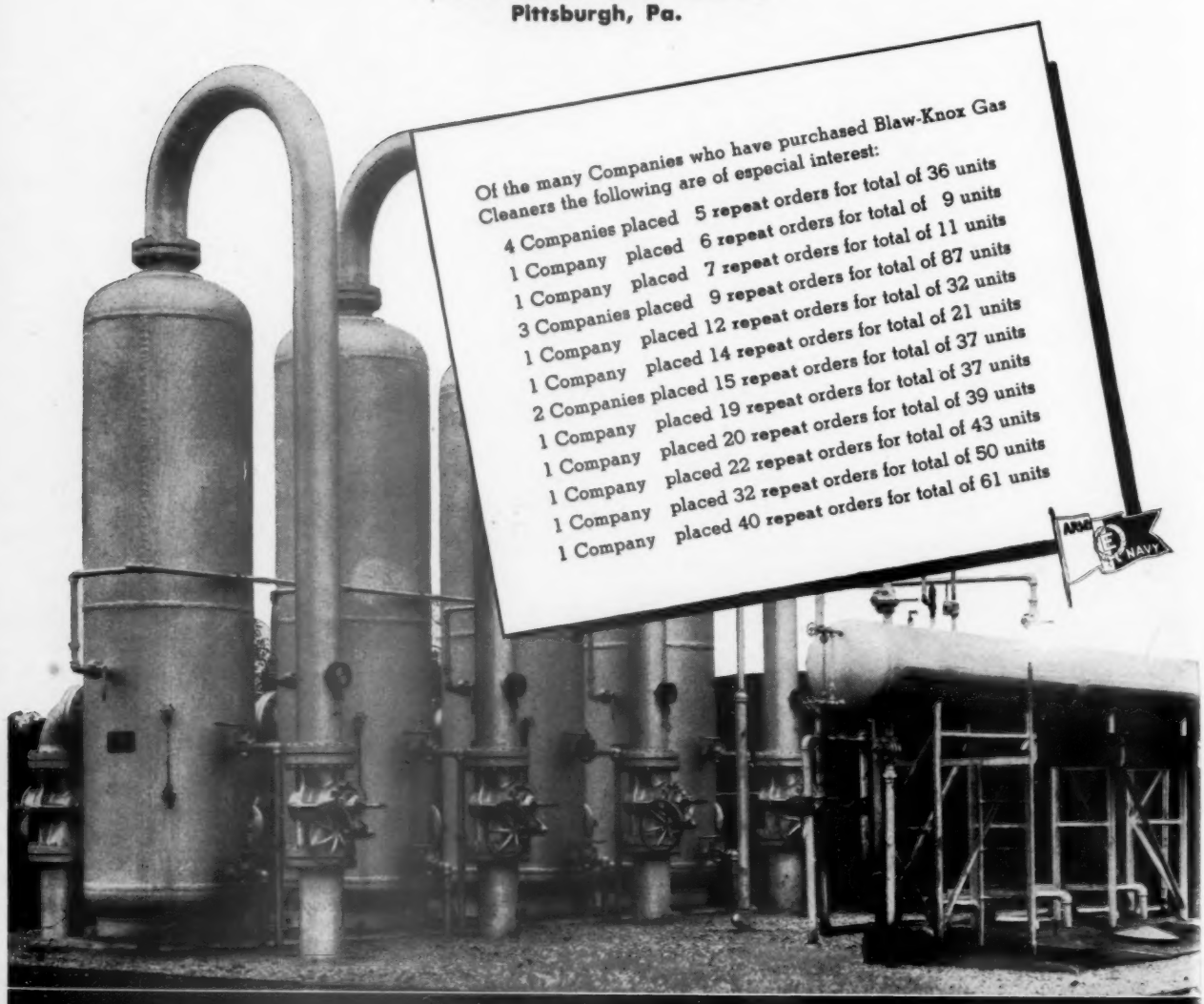
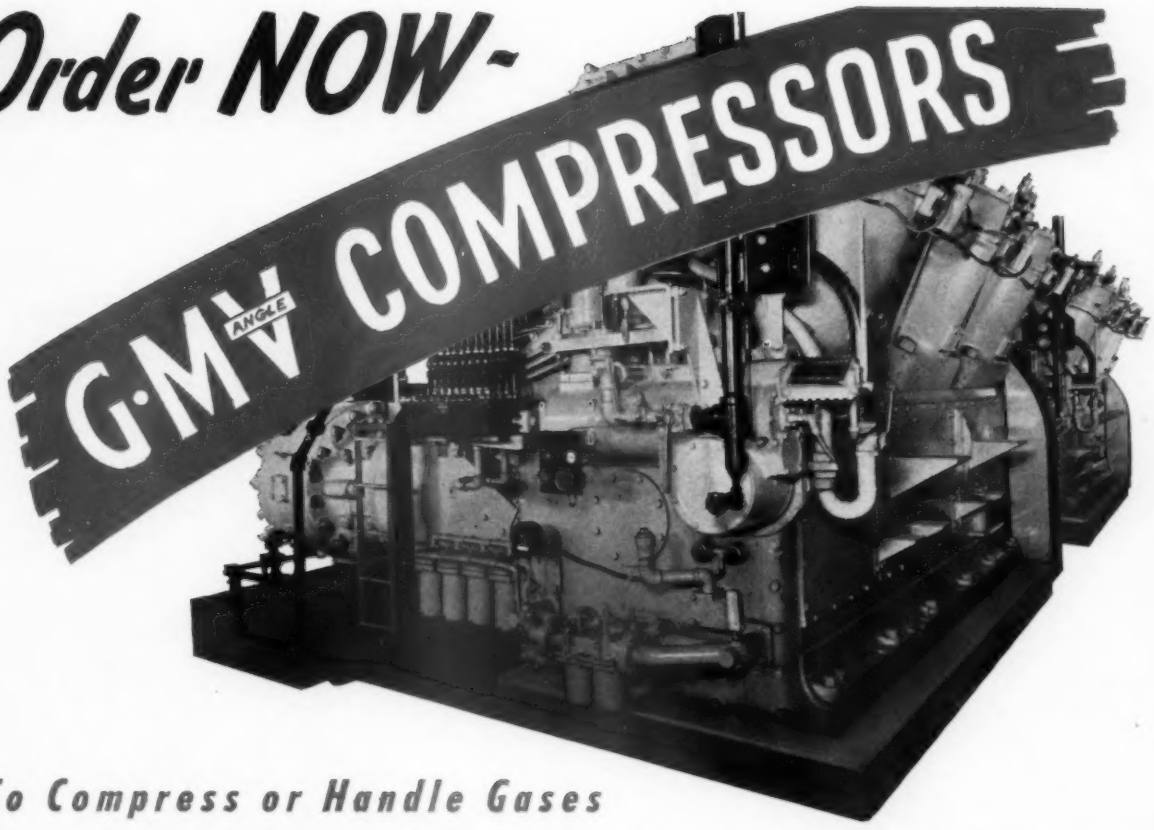

Of the many Companies who have purchased Blaw-Knox Gas Cleaners the following are of especial interest:
4 Companies placed 5 repeat orders for total of 36 units
1 Company placed 6 repeat orders for total of 9 units
1 Company placed 7 repeat orders for total of 11 units
3 Companies placed 9 repeat orders for total of 87 units
1 Company placed 12 repeat orders for total of 32 units
1 Company placed 14 repeat orders for total of 21 units
2 Companies placed 15 repeat orders for total of 37 units
1 Company placed 19 repeat orders for total of 37 units
1 Company placed 20 repeat orders for total of 39 units
1 Company placed 22 repeat orders for total of 43 units
1 Company placed 32 repeat orders for total of 50 units
1 Company placed 40 repeat orders for total of 61 units
NAVY

BLAW-KNOX GAS CLEANERS

Order NOW-



To Compress or Handle Gases At Lowest Cost — for Plant Improvement or Expansion

You may want a compressor quick—for a new plant, or for plant improvement, or expansion. If so, let's get together now.

Your Cooper-Bessemer Compressor is not a puny "war model," designed as a stop-gap or built for the emergency. It handles or compresses gases or air at rock-bottom cost. Every machine we ship, now or after Victory, is as dependable as the best we've ever made. It's the same top-quality, time-proven construction that's piling year upon year of uninterrupted, satisfactory performance for our compressors in such vital fields as gas transmission, repressuring or recycling, petroleum refining, synthetics and the process industries. Powered by a rugged, efficient, economical G-MV engine, either gas or diesel fueled—or motor driven, if you prefer.

We're taking orders today for compressors and engines. Our plants face no reconversion problems. We are ready to serve private industry in 1944.

Let us help you make a start on your 1944 equipment problem now. We'll be glad to hear from you now — to determine what models best serve your needs, and get your compressors and engines earmarked in advance on our 1944 delivery program. Today is not too early.

THE Cooper-Bessemer CORPORATION

Mount Vernon, Ohio Grove City, Pa.

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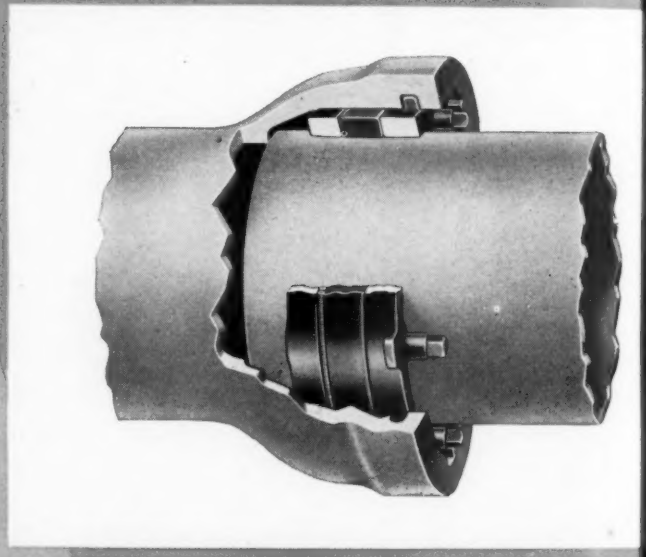
Light-Weight and Easy-to-Handle

DRESSER Bellmaster Joints

Style 85

FOR CAST-IRON PIPE LINES

This 6" Dresser Bellmaster only weighs 8 lbs.



Above you see a workman holding a 6 inch Dresser Bellmaster (weight, 8 lbs.) just as it reached the storeroom—a completely factory-assembled unit, ready for work.

It will take the workman no more than 2 to 5 minutes to make up the permanently tight pipe connection. He has only to wipe out the bell, insert the Joint, wipe and stab in the spigot, and tighten the capscrews with a small wrench. No bell-holes needed.

The cutaway view illustrates the working principle of this new mechanical Joint. A resilient gasket is compressed between two light, strong, malleable rings and against the pipe, by capscrews. This effects a constant, flexible seal, bottle-tight even under unusual conditions of expansion, contraction, deflection and vibration.

Thus effectively the ancient problem of cast-iron pipe joining has been solved. The Joint itself, locked in the bell of the pipe, is safe from attack by corrosion. CIP lines are given new protection from leaks and breaks —new operating efficiency.

Grooves rough-cast in the inner circumference of the bell accommodate the locking lugs, and slots on the face of the bell permit lug passage. Your regular source of supply can furnish Bellmaster pipe—and we are ready to make prompt delivery of Bellmaster Joints. Sizes 3", 4", 6", 8", 10", 12", 16" CIP.

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ONE OF THE DRESSER INDUSTRIES

VOLUME 160
NUMBER 5

AMERICAN GAS JOURNAL

ESTABLISHED 1859

WHOLE
NUMBER 3843

MAY 1944

PUBLISHED MONTHLY BY
AMERICAN GAS JOURNAL, Inc.
53 Park Place, New York 7

S. G. KRAKE, *President and Treasurer*

M. E. KELLEHER, *Secretary*

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10515 Wilbur Ave., Cleveland 6, Ohio
Tel. Sweetbrier 0052

Copyright, 1944, American Gas Journal, Inc.

Subscription $2.00 per year U.S.A.; $3.00 Canada; $4.00 Foreign. Single copies, 25 cts.

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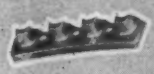
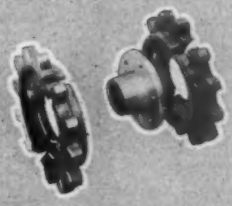
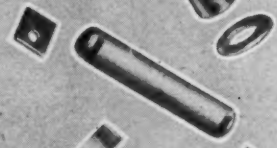
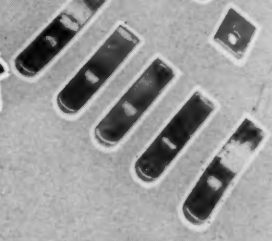
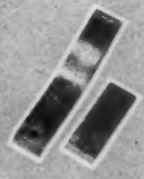
Dependable Parts Service Keeps "CLEVELANDS" ON THE JOB—

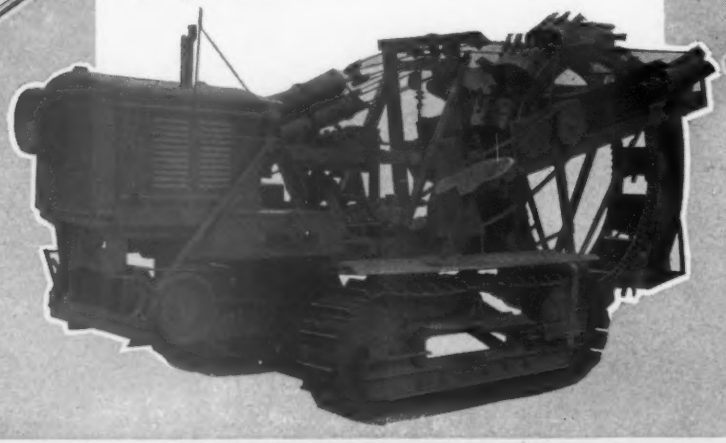












BREAKING production records for new machines to meet military demands is only part of the job.

Servicing hundreds of machines (some fifteen to twenty years old) is another tough, important job.

"CLEVELAND'S" recognition of this problem by maintaining superior parts service has won many spontaneous expressions of owner-approval.

"CLEVELAND" will maintain this vitally necessary quality service, and recommends that you as an owner do your part by paying regular attention to lubrication—keeping all bolts tight—using sharp rooters.

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"CLEVELANDS" Save More . . . Because they Do More

MAY
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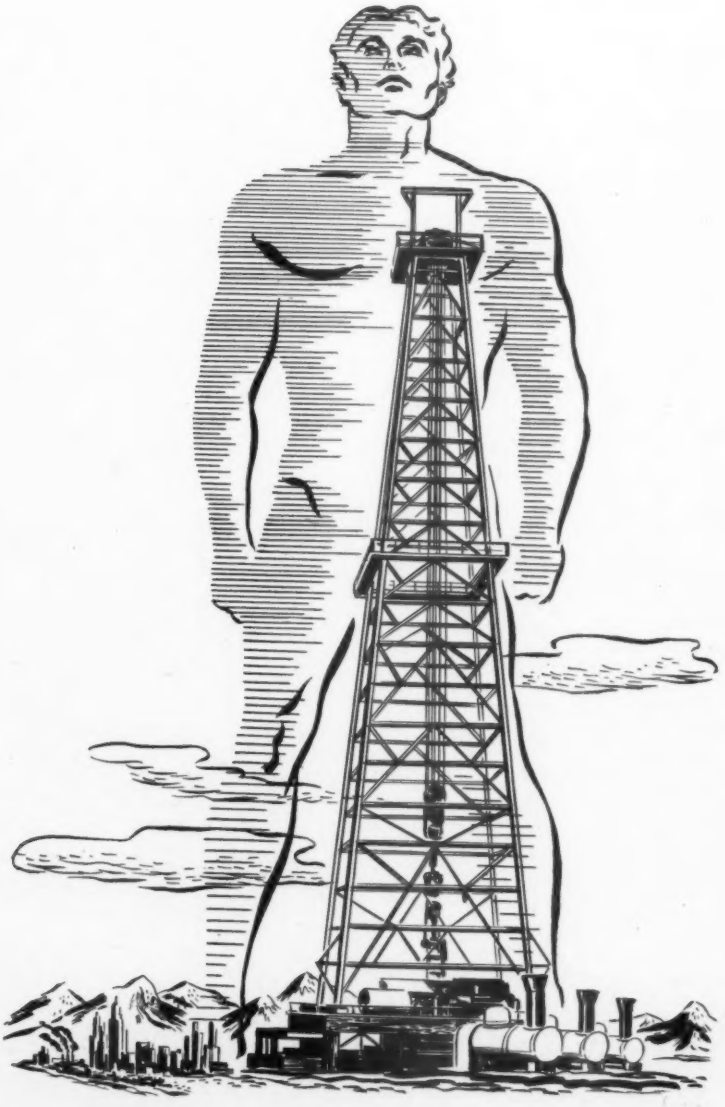
AMERICAN
GAS JOURNAL

VOLUME 160
NO. 5

Natural Gas,— A Heat and Power Colossus of American Industry



THE FOLLOWING pages will give the reader an overall picture of the remarkable growth of the natural gas industry during the past decade.

Up to World War I, the growth of the industry was relatively slow. Most of the gas was used in field operations and for domestic and industrial needs in restricted areas. Today its importance in the economy of the nation is constantly increasing.

This series of articles records the discovery of the great natural gas fields of the Southwest and other parts of the country; the spread of our great systems of transmission lines from the fields in every direction to serve millions of domestic customers, and to serve industry in a multitude of ways.

Again, natural gas has become an adjunct in the manufacture of many products, such as gasoline, synthetic rubber, carbon black and many other items. Large quantities of natural gas are also used in the manufacture of glass, ceramics, terra cotta, steel products and many other articles.

The data included in these articles was obtained by personal interviews with the operating men in industries where natural gas is a factor in the production of their product and from the Bureau of Mines.

In presenting this material to the gas industry, the American Gas Journal has endeavored to record the phenomenal advance of the various uses of natural gas as developed over the past few years.

Early History of Natural Gas

ALTHOUGH natural gas was burned at Fredonia, New York, York, in 1821, as a mark of honor to General Lafayette, who visited that place in his triumphal tour of the United States, and twenty years later was employed in a small way in firing the salt furnaces of the great Kenawka Valley, it was not until the early seventies that its commercial potentialities were exploited. The first utilization of the fuel appears to have been at Erie, Pa., where it was employed, first to fire the boilers of the local waterworks, then in other industrial practices, and in November of the same year to light the city streets. The following year gas was discovered at Painesville, Ohio, and a year later at Cleveland. In July, 1872, the great well near Titusville, Pa., was brought in, and in the same year what was probably the first pipe line, that of the Bloomfield & Rochester Natural Gas Company, was constructed. It was built of wood, and ran from Bloomfield to Rochester, a distance of approximately 25 miles. Through faulty construction, and the unwillingness of consumers to use the gas, which they claimed was inferior to the manufactured product, however, the venture was a failure. (Only this year, incidentally, have homes of the Kodak been once again supplied with natural gas.) The first iron pipe line is said to have been constructed in the Titusville area in 1873. A year later gas was being transported by an 18-mile line to Pittsburgh, being used to fire the boilers and heating furnaces of an iron foundry. Ten years later gas was being used in the steel center in a very large way, one mill alone using a million cubic feet hourly.

Formative Period of the Industry

Then followed a period of slow but sustained growth, resulting chiefly from the discovery of new gas reserves in the frenzied search for oil, the world's new liquid gold. Anomalous as it may seem, the oil driller hated the thought of natural gas, and it was permitted to go to waste. Today it is his chief ally, for it is his source of heat in the drilling of his wells. Without it, the deep wells of the present, some of them more than two miles down into the earth, would be impossible.

Of course, the industry had its periods of retrogression as well as progress, for the great reserves of today had not been discovered, nor the technological advances, which have made the industry what it is today, recorded. Compression was unknown in those days, and the deep well of today had not been visualized by even the most enthusiastic believers in the fuel. Gas fields had the habit of petering out with uncanny regularity in the early days, and when they did the communities effected had to go back to coal again. The natural gas industry then was essentially a mining proposition; today it is rapidly becoming a public utility in the broadest sense of the term. Until twenty years ago the exploitation of a gas field differed little from the development of a gold or silver property. The gas producers gave little thought of the tomorrow. When a field had been exhausted, the enterprise was abandoned, that is, of course, unless other reserves had been uncovered in the meantime. Such an economically unsound practice led naturally to chaotic industrial conditions.

Prior to the discovery of the great Monroe field in North Louisiana, there was always the problem of exhaustion of supplies. Today, the problem is inadequate markets, attributable in great part to failure in judgment of market analysis.

Growth Before World War 1 Was Slow

Until that Great War, the growth of the natural gas industry was relatively slow, and most of the gas was used in field operations, in the manufacture of carbon black, and for the domestic and industrial needs of restricted areas. The world struggle, however, with its increased industrial impetus, brought an acute demand for new fuel sources. This led, of course, to a more intelligently directed search for reserves of natural gas. Thus, with the development in a large way of the great Monroe field, of North Louisiana, discovered in 1918; the subsequent discovery of the even greater Panhandle field, of Texas, and of other great fields in various parts of the country, making available to man's use huge reserves of the fuel, the industry commenced to assume economic importance, for then only was it possible to attract from the investor the vast sums of money required to provide the pipelines and other physical facilities, and attract engineering skill that are fundamental to the prosperity of any industry.

The Geography of Natural Gas

Occurrence and Distribution

Although natural gas is found in many different parts of the world, occurring in the United States, Canada, Mexico, Peru, the Argentine, Great Britain, Italy, Russia, Roumania, Hungary, Persia, China, Japan, and other countries, and while its existence has been known for thousands of years, it having been perhaps, the fuel utilized for the Perpetual Fires of Baku, it is only in the first two countries that its commercial exploitation has been undertaken to any considerable degree, these two countries at present accounting for 95 per cent of the world's annual yield.

In Canada, natural gas is found in New Brunswick, Ontario, Saskatchewan and Alberta, the last-named province having considerable reserves, about 500 billion cubic feet having been proven to date. Canadian production in 1936 was 26,947,876 MCF, the chief producing provinces being Alberta, with 16,843,957 MCF, and Ontario 9,410,730 MCF, the remainder being divided between Saskatchewan and New Brunswick.

It is estimated that there are about 35,000 square miles, or at least 2,240,000 acres of gas-bearing lands in the United States, and that present annual depletion is at the rate of about 325,000 acres, or more than six times the figure of present annual gas reserve discovery.

Natural Gas in the United States

The present chief natural gas regions of the United States are: Appalachian District, embracing portions of West Virginia, Pennsylvania, New York, Ohio, Tennessee, and Kentucky; Mid-Continent, comprising parts of Kansas, Oklahoma,

Texas and Arkansas; Gulf Coastal, including Louisiana and Texas areas; Rocky Mountain, embracing Montana, Wyoming, Utah, Colorado, and New Mexico, and Pacific, confined almost exclusively to California.

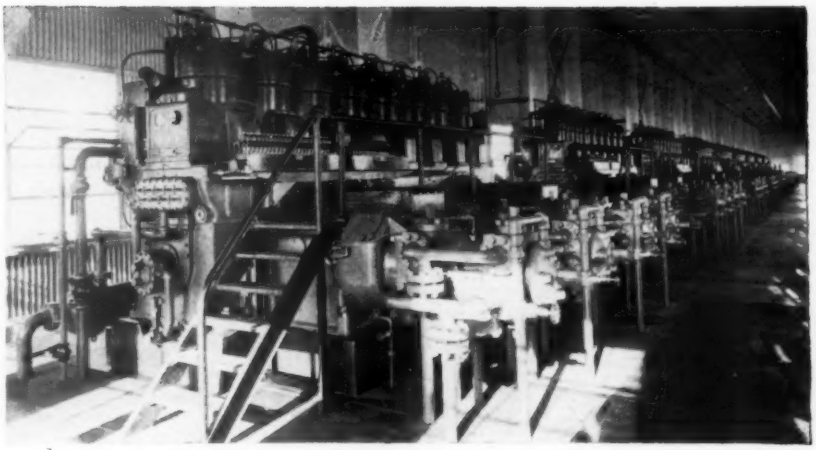
There are approximately 15 great natural gas producing areas in the United States, which the well-known geologist, Henry A. Ley of Dallas, Texas, has estimated to contain at least 75 trillion cubic feet of recoverable gas, a figure of such tremendous proportions that the lay mind can hardly grasp its significance. It is sufficient to state, therefore, that, utilized to the full, this vast supply of latent energy could fuel the nation's homes and industries with 2 billion feet of the gas a day for more than a century.

Panhandle of Texas the Greatest of All Gas Fields

The greatest of all existing gas fields is the Panhandle of Texas, which has a present proved area of approximately 1,500,000 acres, and estimated reserves of 16 trillion cubic feet, or more than a fifth of the national total. Discovered only in 1918, this vast reservoir, essentially a gas field, although it also produces some oil, has yielded to date approximately 3 trillion cubic feet of gas, and, in addition, another estimated 3 trillion cubic feet has been emptied on the open air. Now, however, conservation measures have been instituted that have materially reduced this waste, and it is anticipated that before long, with state and operators cooperating, conditions will be as favorable as those of California, where present wastage is estimated at 6 per cent, compared with 60 per cent in 1930, one of the most remarkable examples of conservation in the country's history. The geologists, V. Cotner and H. R. Crum, have estimated that 900,000 acres of the proved part of the field to have had an original reserve of 16,100 billion cubic feet.* The Panhandle Field has a present open-flow capacity of about 16,500 million cubic feet a day, and its 649 wells are producing approximately 450 billion cubic feet of gas annually, of which 250 billion cubic feet are sweet gas. The field is connected by pipe lines with Dallas, Fort Worth, Denver, Omaha, Kansas City, Minneapolis, St. Paul, Chicago, Detroit, and hundreds of other centers in the same geographical regions.

According to the Texas Railroad Commission, the State of Texas had as of June 1937, 320 gas reservoirs, and their 2,845 wells were producing daily an aggregate of 2,300 million cubic feet of gas a day, of which the pipe lines were taking 48.43 per cent.

Adjacent to and north of the Panhandle, is the Hugoton Field of Oklahoma and Kansas. It has an indicated area of from 1,500,000 to 2 million acres, of which the 388,000 acres already proved are believed to contain at least 3,100 billion cubic feet.



La Gloria Corporation condensate recovery plant at Falfurrias, Texas. Here 11 Clark 8 cylinder, 800 B.H.P. gas engine driven compressors are in operation.

Monroe, A Gas Field Exclusively

The Monroe Field, purely gas, no oil ever having been found within its confines, has an open-flow capacity 4,563,725,000 cubic feet a day, and its 800 wells have an aggregate present production of 181,693 million cubic feet. In 1921, H. W. Bell and R. A. Cattell, of the Bureau of Mines, estimated the total recoverable reserves of this field at 4,375 billion cubic feet.** To date approximately 2 trillion cubic feet have been produced, leaving an equal amount to be utilized.

The Natural Gas Resources of California

California is another state with vast stores of natural gas, having estimated total reserves that are variously computed by different authorities. Claude C. Brown, former Consulting Chief Engineer, California Railroad commission, for example, places the figures at 18 billion,* and Harold W. Hoots and Stanley C. Herold, being more liberal, estimate them at 34 trillion.** During the year 1936, 351 billion cubic feet of gas were produced, all of it being consumed within the state. The gas came from 39 distinct fields, only nine of which were gas fields exclusively. The three principal productive areas were the San Joaquin Valley, the Coastal Area, and the Los Angeles Basin. The chief single field was the famous Kettleman-North Dome, which last year accounted for approximately one-third of the state's total yield. California's gas was produced from 11,125 wells. No intelligent estimate of California's reserves can be made, as more than 98 per cent of all of its natural gas is produced with oil, meaning that the life of the industry will be dependent on the duration of the state's oil operations. A conservative estimate of the life of the present fields would be fifteen to twenty years, but it is probable that other reserves will be uncovered before those now defined have reached the exhaustion point.

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* *"Geology and Occurrences of Natural Gas in Amarillo District, Texas," American Association of Petroleum Geologists, 1935.*

** *"The Monroe Gas Field," Bulletin 9, Department of Conservation, State of Louisiana, 1921.*

* *From data supplied by letter to the Bureau of Mines.*

** *"Natural Gas Reserves of California," American Association of Petroleum Geologists, 1935.*

A Decade of Continuous Progress

What has been accomplished in the natural gas industry in the past fifteen years belongs to the category of the seemingly impossible. Existing fields have been extended, and new fields discovered. More than 50,000 miles of long distance transmission line, much of it from fifteen inches to twenty-four inches in diameter have been constructed, bringing this greatest of all sources of heat to a majority of the chief industrial centers of the country. New and greater compressor stations have been designed, and there has been a defined improvement in technique, especially in the welding of pipe, and in the pipe itself, which is very different from the cast-iron material of pioneer days. Old time hand regulation, too, has been superseded by a highly developed and efficient system of automatic control, while modern appliances of many kinds have superseded the crude perforated burners that were general not so many years ago. The decade and a half now drawing to a close has been a period of almost continuous growth, reflecting the inherent soundness of the industry that now represents an aggregate capital investment of nearly three and a half billions of dollars, and is marching straight ahead.

The Statistical Position of the Industry

How striking has been the increase in the production of natural gas in the last few years is shown vividly in the comparative statistics for the years 1938 and 1942, compiled by the Bureau of Mines. The 1943 figures are not yet available, but it is believed that they are at least 10 per cent higher than those for the previous year.

PRODUCTION OF NATURAL GAS

Millions of Cubic Feet

	1938	1942
California	315,168	403,968
Louisiana	283,899	447,686
Oklahoma	263,164	269,704
Texas	882,473	1,170,345
West Virginia	134,342	215,193
Pennsylvania	76,547	93,532
Kansas	75,203	112,921
New Mexico	50,706	78,164
Ohio	35,257	45,055
Wyoming	26,678	33,124
Montana	21,216	31,475
New York	10,402	8,718
Other states	120,507	143,590
Total	2,295,562	3,053,475

According to the market report issued by the Bureau of Mines in January of this year, this record output of natural gas was utilized as follows: Field use 721,063,000,000 cubic feet, or 24 per cent; domestic 498,537,000,000 or 16 per cent; commercial 183,603,000,000 or 6 per cent; carbon black manufacture 335,533,000,000 or 11 per cent; petroleum operations 201,670,000,000 or 7 per cent; power plants 238,736,000,000 or 7 per cent, and industry 865,000,000,000 or 29 per cent.

The gas had a value at the well of 5.1 cents a thousand cubic feet in 1942, the highest since 1937 and an average value of 22.7 cents at points of consumption. The total value of the gas at consuming points approximated $700,000,000 compared with $500,550,000 in 1938.

Steady Growth of the Industry

The consistent growth of the natural gas industry since this fuel became an important factor in the national economy toward the close of the nineteenth century is further shown in the following table, which furnishes what are believed to be reliable statistics covering each five-year period from 1900 to 1940, and annually thereafter:

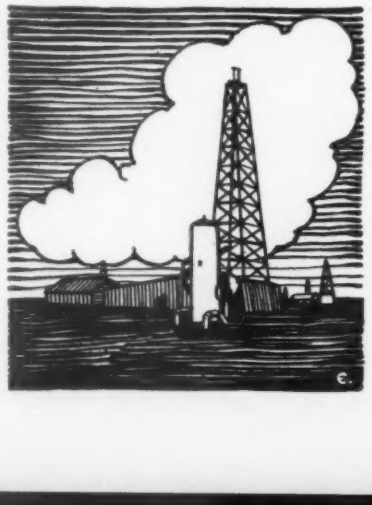
FORTY-THREE YEAR RECORD*

Year	Consumption, MCF	Customers	Revenues
1900	160,000,000	525,000	$ 23,600,000
1905	403,292,000	1,110,000	57,540,000
1910	509,000,000	1,345,000	70,756,000
1915	628,000,000	2,213,000	101,000,000
1920	798,000,000	3,433,000	196,000,000
1925	1,188,000,000	4,020,000	305,000,000
1930	993,231,000	6,325,000	389,880,000
1935	1,038,513,000	6,116,000	380,761,000
1940	1,443,600,000	7,887,000	494,928,000
1941	1,607,911,000	8,253,000	528,073,000
1942	1,767,814,000	8,516,000	583,590,000
1943	1,983,487,000	8,754,000	633,195,000

‡ *Estimated.*

* *The figures shown in the above table from 1930 on are those of the Statistical Division of the American Gas Association; those prior to are from the Bureau of Mines and other sources. The figures shown do not include fuel used in the field or in carbon black manufacture.*

	1934	1942
TOTAL PRODUCTION	1,770,724,000 mcf	3,053,475,000 mcf
CONSUMPTION		
Domestic	442,067,000 mcf	498,537,000 mcf
Commercial	———	183,603,000 "
Electrical Generation	127,896,000 "	238,736,000 "
Industrial	393,155,000 "	1,201,164,000 "
Carbon Black Manufacture	241,589,000 "	335,533,000 "
Field Operations	554,542,000 "	721,063,000 "
Petroleum Refining	79,965,000 "	201,670,000 "



In the past decade not only has great growth been experienced in the natural gas industry, but there have been definite changes also in utilization, as will be seen from a perusal of the above table for the years 1934 and 1942. The figures are those of the Petroleum Economics Division of the United States Bureau of Mines:

Estimates of Present Reserves of Natural Gas

Present reserves of natural gas are variously estimated at from sixty to a hundred trillion cubic feet, sufficient to meet the normal demands of industry for the next seventy-five years. In considering the question of future supply, one must not overlook the pronounced technical advancement of recent years, making it possible to locate structures that may contain gas deposits at a depth of over a mile. Another factor to consider, too, is the effect of conservation on the life of the gas fields. According to the state's Geological Survey, more than 25 per cent of the 8,800 billion cubic feet of natural gas produced in West Virginia in the half century 1885-1935 was wasted,* and certainly the record of some of the other states would be more appalling.

A very well-known authority, Ralph E. Davis, of New York, who has given the question of gas reserves a great deal of careful study, estimates the present recoverable reserves of the United States as follows:

	Billions of Cubic Feet
Appalachian	7,000
North Central	100
Mid-Continent and Gulf Coast	47,000
Rocky Mountain	2,000
California	5,900
Total	62,000

"Of the three mineral fuels—coal, oil and natural gas—the latter is the most easily extracted from the earth," says Davis. "Gas fields that have been abandoned are known generally to have yielded approximately 90 per cent of the total amount of the gas in the reservoirs. Of oil, only about a fourth is recovered, and at least a third of all coal mined must be left in the seams."

"Careful distinction should be made," said the late Dr. John Wellington Finch, a former Director of the Bureau of Mines, "between the quantity of gas recoverable from proved reserves and the quantity that may be expected from areas and formations not yet thoroughly explored. Garfias and Whetsel** have stated that "while estimates of *possible* and *probable* oil deposits are as a rule but idle conjectures, appraisals of *proven oil reserves* can undoubtedly be made with an ever-increasing degree of accuracy." The same can be said of estimates of natural gas reserves.

"When gas reserves are discussed, probably a majority of producers hope for big figures and long life. People in such a group probably are disappointed because an outright statement in years can not be given. The future of the industry depends upon many factors besides the quantity of gas underground. The broad engineering, industrial, and economic view calls for careful analysis to avoid immature conclusions that might retard constructive thinking and action. We must consider not only the known quantity of gas in developed fields, and its economic availability, but also the probabilities and possibilities of discovering additional reserves, the effect of increased knowledge and improved technique in geology and geophysics; improvements in drilling and production practices, making possible recovery of gas from deeper horizons, advances in conservation of natural gas, not only in dry-gas fields but also in oil fields through decreased gas-oil ratios and better utilization of reservoir energy, possibilities of storing surplus gas in natural underground reservoirs, improvements in pipeline transportation, making practicable the delivery of gas from more remote sources; increased efficiency in use of gas; possibilities of mixtures of natural gas and gases from other sources, and many other factors."

Discussing the question of available reserves in their annual review of the industry, H. S. Kennedy and H. C. Fowler, of the Bureau of Mines, write:

"Although various estimates have been made of known gas reserves, and on these bases computations have suggested the possible duration of known supplies at present rates of consumption, there is a definite feeling by those who have studied the problem seriously that there are undeveloped and undiscovered sources of natural gas to supply new and extended markets. When better business conditions warrant, new lines probably will bring additional gas to waiting markets, where, as in the past, it will take its place as a competitive fuel.

Natural gas is composed chiefly of marsh gas, technically known as methane, the percentage of this gas frequently exceeding 80 per cent of the whole. It is odorless* and colorless, and when of superior grade has very little fume, and, to a degree, non-toxic, but it is irrespirable, and consequently asphyxiatious when sufficiently concentrated. Both methane and ethane are defined as simple asphyxiants by Henderson and Haggard in their standard work of reference. Natural gas burns with a steady flame, being characterized as "wet" or "dry" according to its gasoline content. Its theoretic fuel value is very high, on an average 1,000 to 1,100 B.t.u.'s per cubic foot, which interpreted means that it is at least twice as high in British thermal units as gas produced from coal. Although its exact origin is unknown, scientists are preponderantly of the opinion that both natural gas and petroleum oil are of organic origin.

Origin and Occurrence

Many different theories as to the origin of natural gas have been advanced since the first days of its discovery, but that given the widest credence today is thus expounded by John Diehl.

"The origin of gas and oil has been made the subject of much debate by geologists and chemists. The most generally accepted belief is that they have been formed by chemical action induced by heat and compression acting upon marine organisms buried in the sands at the time they were deposited along the seashore in past ages. These sands subsequently settled very slowly, being overlaid by other deposits and sediments, sometimes hundreds of feet in depth. As the overburden increased, compression and heat consolidated the sands and some of the overlying materials as rock formations. Ages afterward, great areas of the seashore were raised, forming land surfaces which

*Survey of Natural Gas of West Virginia for the West Virginia Public Service Commission by the West Virginia Geological Survey.

**"Proven Oil Reserves," V. R. Garfies and R. V. Whetsel, Transactions, American Institute of Mining and Metallurgical Engineers, Volume 118, Petroleum Development and Technology, 1936.

*As a result of the New London school disaster, Texas has enacted legislation to make the odorization of gas compulsory although it should be stated in justice to them that it has been the practice for some time of many of the major companies to odorize all gas sold to domestic and commercial users.

were partly eroded and washed away. Subsequently, some of these areas settled slowly under the water and other deposits were formed, including strata which contained sufficient remains of various organisms to form another gas or oil sand. These uplifts and settlements were repeated many times over a period which lasted millions of years."

Because of its methane and ethane hydrocarbons, natural gas is an ideal producer of energy, and, its high heating value per unit of volume, makes it particularly suitable for a myriad of industrial, commercial, and domestic applications.

Generally speaking, but not necessarily, natural gas is found in association with oil, occurring for the most part in rocks of Mesozoic, Devonian, Carboniferous, Tertiary, and, particularly in the Rocky Mountain area, in the upper and lower Cretaceous ages, being found at depths ranging from 500 feet to several thousand feet, principally trapped in sandstone formations of loose texture, in shale seams, and in cavities. It is found chiefly on the structure known as an anticline.

Approximately 55 per cent of all natural gas produced reaches the surface with oil. The oil industry of the United States is by far the greatest on earth. To the end of 1935, according to the Bureau of Mines, more than 30 billion barrels of oil had been discovered in the country, nine-tenths of which have been located since the turn of the century, and more than half since 1921. There are aproximately 350,000 oil wells in the United States today.

Natural gas is drilled for in the same manner as is oil, a derrick being erected and a well sunk, the well being cased where conditions necessitate. There are two methods of drilling, percussion and rotary. The first, in which cable tools are employed, is the pioneer method, and still the most common. The second used chiefly in soft formations, such as prevail on the Gulf Coast. As a rule, the pressure of newly drilled deep wells is terrific, not infrequently being sufficiently powerful to blow the one-and-a-half ton "string" of drilling tools employed in the cable method of drilling completely over the derrick, and occasionally the formation pressure has been so great that the drill pipe and bit used in the rotary method, weighing many tons, have been forced out of the drill hole. This great force is attributable to what is known as rock pressure, which in the case of new wells, ranges up to a maximum of 2,600 pounds to the square inch.

Wells vary greatly in open flow capacity, ranging from less than a million to 200 million cubic feet of gas a day, and their length of life runs from a few to many years, depending on the size and extent of the deposit and the rate of consumption. In the early stages of a well's life, natural pressure is, as a rule, sufficient to force the gas through pipe line and mains, but when rock pressure commences to show appreciable decline it is necessary to supplement it with compressors, or pumps. So many factors enter the situation, such as initial pressure, diameter of pipe line, distance to market, and rate of production, that it is impossible to say how long a given well will deliver gas into a pipe line without compression. In 1890, a gas well could be sunk to a depth of only 2,900 feet, and even ten years ago a well of 3,500 feet was considered extraordinary, but today, because of the great technological advances, gas wells of over a mile in depth are common.

Growing Use in Oil Refining

Approximately 18 per cent of all fuel used in the six hundred petroleum refineries of the country is natural gas, consumption in 1942 having amounted to 201,670,000 mcf, an increase of 36 per cent over the previous year, which also showed a 16 per cent gain over 1940. Fuel oil on the other hand, showed a loss of 1.6 per cent. Approximately 54,200 mcf were used in the production of a portion of the nation's 85 million barrels of Portland cement in 1941, an increase of 23 per cent over the previous year.

The wide employment of natural gas in general industry was commented on as follows in an annual report of the Bureau of Mines:

Large quantities of natural gas are used as fuel in the manufacture of glass, ceramics, terra cotta, steel goods, and various other articles, where an accurate control of temperature and a virtual absence of foreign material in the fuel are essential, says the Bureau of Mines. Most of the business commands a price of from 10 to 35 cents a thousand cubic feet, which it feels is probably not much above the cost. However, this business helps to improve the load factor, especially in summer, when domestic and commercial demands are at their lowest. It is estimated that about 1,200,000,000 cubic feet of natural gas were consumed for industrial purposes in 1943, an increase of about 8 per cent over the previous year, and greater than 1937 up to that time the record.

In 1942 130,000,000 cubic feet of natural gas were exported to Canada and 8,572,000,000 cubic feet to Mexico, which showed over the previous year gains of 7 per cent and 17 per cent respectively. Exports to Mexico were at an all-time high, exceeding by a billion and a quarter cubic feet the previous peak year, 1936.

Importance of Natural Gas in Gasoline Production

Formerly, all natural gas was burned just as it came from the well, but now, wherever practical, its gasoline content is first extracted. In 1941, the last year of record, according to the Bureau of Mines, 2,763,000 mcf of gas were so processed, each thousand cubic feet yielding, on an average, a gallon of gasoline, although in some cases the yield was much better, attaining nearly two gallons in Oklahoma. Production in 1941 represented an increase of 12 per cent compared with 1940. Louisiana and Texas showed gains of 32 per cent and 16 per cent respectively, largely because of increased cycle-plant operation. However, little affected by such operations, Kansas increased its natural gasoline output 17 per cent and West Virginia, 16 per cent.

Three methods were employed in this extraction: Absorption, compression and the charcoal process, more than 1,380,000,000 gallons, or 90 per cent of the total having been recovered by the first method, 148,000,000 by the second, and only 7,000,000 gallons by the last.

Natural gasoline is of such highly volatile character that it must be diluted with a lower-gravity product, and for this reason is generally blended with gasoline extracted from crude oil.

The leading producers of natural gasoline are in order, Texas, California, Oklahoma, West Virginia, Louisiana, Kansas and New Mexico, the first two states producing together approximately 60 per cent of the total. There are nearly five hundred natural gasoline plants in operation today.

Expansion of Gas Transmission Lines

Perhaps the most outstanding development of the natural gas industry is the extraordinary growth of its transmission system, which, in its ramifications connects the chief gas fields with thirty-seven of the forty-eight states, bringing nearly two billion cubic feet of natural gas a day to some 9,000,000 domestic, commercial, and industrial consumers, giving a majority of the great urban centers of the country the benefit of this fuel, whose average price is equivalent to coal at $1.25 cents a ton and crude oil at thirty cents a barrel. From this, it is easy to appreciate what possession of this most economical and efficient of all sources of heat has meant to the growth in very recent years of such Middle Western cities as Detroit, Toledo, Cleveland, Cincinnati, Akron, Pittsburgh, Youngstown, Chicago, and St. Louis, and such Southern cities as New Orleans, Atlanta, Houston, and Dallas, whose expansion during the past three years of war would not have been possible without this great gift of nature to man.

At present there are about 55,000 miles of natural gas transmission lines, with other hundreds of miles building or projected, and it is reasonable to expect that when hostilities cease new projects will be undertaken. For actually there is no shortage of natural gas, but the facilities to distribute it. If one stops to realize that present proven reserves are authoritatively estimated at ninety trillion cubic feet, which, even at the present inordinate rate of consumption, attributable to war, would last for more than fifty years, without taking into calculation either new discoveries or technological advances that will mean better conservation and materially increased consumption. Then, who can say that some day these pipelines may not be serviced with manufactured gas, produced at the pithead. We must not forget that the country's coal deposits are perhaps a hundred and fifty times as great as those of oil and natural gas combined.

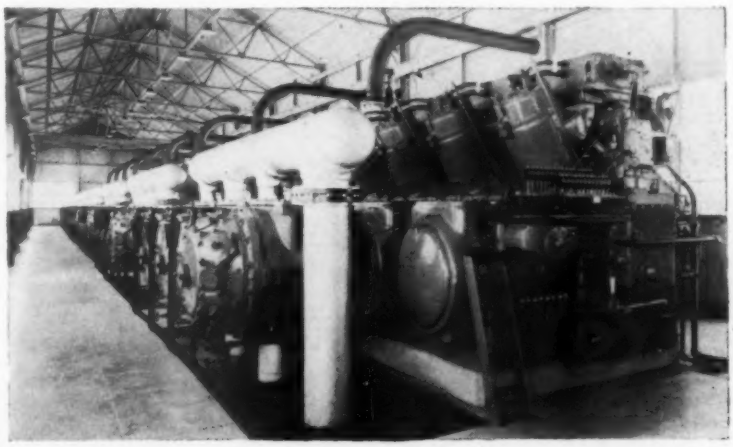
Gas transmission by pipeline is by no means a new departure, for the first long-distance system was established in 1891. This was the pipeline of the Indiana Natural Gas and Oil Company, which connected the natural gas fields of Northern Indiana with the city of Chicago. It has a length of one hundred and twenty miles, a diameter of eight inches, and delivered gas at a pressure of 525 pounds. At the turn of the century, natural gas was also being delivered to various parts of Pennsylvania, Ohio, and New York from the West Virginia fields.

Relatively few in number, however, were natural gas transmission lines until the great natural fields of Louisiana and Texas were brought into production, providing limitless quantities of the fuel for which there was no market. The transmission line was the logical answer to the problem. Today, pipelines, as has been already stated, radiate from most of the important gas fields, bringing thousands of communities the power and heat necessary to place them on a competitive basis with other places more favorably endowed.

An idea of the extent of the interstate transportation of natural gas may be obtained from the Bureau of Mines' figures for 1942, which show that aggregate deliveries approximated 916 billion cubic feet. The gas originated in eleven states, and delivered to 30 different states, including all of those in the highly industrial regions of the country east of the Rockies except New England, New Jersey, and Wisconsin. The chief states from which gas was transmitted, together with the amounts dispatched, were, in order: Texas, 293,404 million cubic feet; Louisiana, 206,663 million cubic feet; West Virginia, 142,925 million cubic feet; Oklahoma, 63,801 million cubic feet; Kentucky, 63,512 million cubic feet; Kansas, 58,843 million cubic feet; New Mexico, 34,210 million cubic feet; Pennsylvania, 22,284 million cubic feet; Wyoming, 13,674 million cubic feet; Montana, 6,308 million cubic feet; Colorado, 4,348 million cubic feet, and Arkansas, 4,351 million cubic feet. Other states transporting the fuel beyond their borders included Illinois, New York, Indiana, Ohio, Utah, and Mississippi.

Approximately 300,000,000 cubic feet of natural gas are now being piped daily from the Panhandle Field of Texas to Chicago through the transmission system of the Natural Gas Pipe Line Company, whose ownership is vested in a number of public utility and oil companies, including Cities Service Company, Natural Gas Investment Company—a subsidiary of Peoples Gas Light & Coke Company — with twenty-seven per cent interest each: the Texas Corporation with seventeen per cent; the Standard Oil Company of New Jersey and the Southwestern Development Company—the latter owned jointly by the Consolidated Oil Company and the Mission Oil Company—with thirteen per cent, and the Columbian Carbon Company, with three per cent.

The pioneer system of the Panhandle Field is that of the Cities Service Company, whose 500-mile pipeline from that area delivers natural gas throughout Kansas and to Kansas City, Missouri. This line, opened in 1931, has probably carried more gas to date than any other one system in the country. It was in this year, too, that the great 24-inch 925-mile transmission of the Natural Gas Line of America, from the Amarillo, Texas, field to Chicago, was placed in operation.



Nine Cooper-Bessemer Type GMV engine-driven compressors, totaling 6200 hp. at 300 rpm, installed in the El Paso Natural Gas Company's Station at Jal, New Mexico for the pipeline transmission of gas. There are four 8-cylinder and five 6-cylinder Type GMV units.

Oklahoma Natural Gas Company, An Integrated System

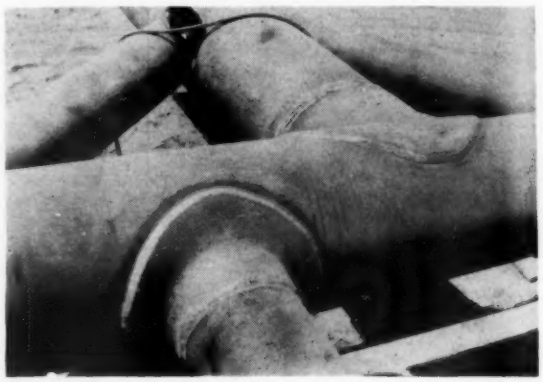
Another homogeneous and highly integrated transmission system is that of the Oklahoma Natural Gas Company of Tulsa, Oklahoma. This is one of the longest established natural gas companies in the country, having been formed in October, 1906. It operates exclusively in Oklahoma, and has no other affiliations.

Oklahoma Natural Gas Company represents aggregate investments of about $60,000,000, and in the fiscal year ending August 31, 1943, had operating revenues of $12,796,245, an increase over the previous year of $1,574,491.

The territory served by this company extends in a generally southwestern direction from Tulsa, in the northeastern part of the state, to Oklahoma City, embracing the larger proportion of the highly industrialized and fertile regions. In addition to the important cities of Tulsa and Oklahoma City, the system serves more than one hundred communities through its own transmission lines, and, in addition delivers gas to the distribution lines of other companies that serve more than thirty towns and villages. Eleven of the communities served by the company have populations of more than 10,000 and about forty of the remainder populations of from 1,000 to 10,000. It served, in 1943, a total of 188,545 customers of which 171,094 were domestic, 16,639 were commercial, 699 industrial, 24 utilities, and the balance, 89 oil and gas drillers. In this region, indeed, natural gas is the universal fuel and it is authoritatively stated that throughout the territory there is no large industry, no large plant, no big office building or other structure that does not use it. Total gas sales were about 55 billion cubic feet, of which approximately 11½ billion cubic feet were produced from the company's own fields, and the remainder purchased.

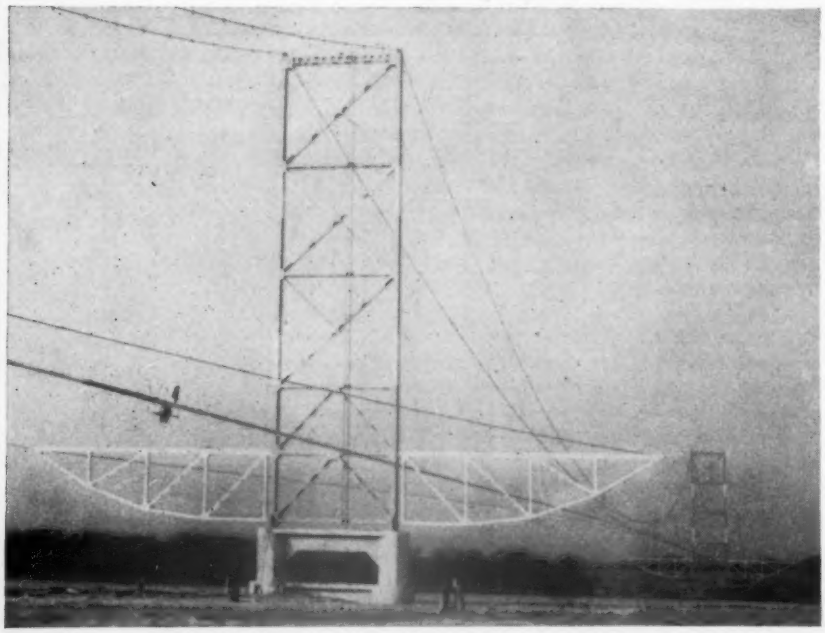
Oklahoma's total mile of pipelines amounted at the end of the fiscal year to 4,964 miles, of which 2,544 miles were main transmission lines. This represented an increase of 886 miles of pipelines since 1939. The company's compression stations had an installed horsepower of 11,160.

Last year the Oklahoma Natural Gas Company constructed what is said to be the longest single-span suspension bridge in the world to carry its 96-mile pipe line across the South branch of the Canadian River. This bridge has an overall length of approximately half a mile, and a main span of 1,760 feet.



This close-up shows electric welded construction of portion of headers for a 22-inch gas line river crossing for Columbia Gas System, Defiance, Ohio.

This bridge with an overall length of 3698 feet spans the South Canadian River in Oklahoma and carries a 12¾ inch transmission line at 880 pounds working pressure.



This suspension bridge across the South Canadian River in Section 30, Township 9 North, Range 3, West, between McClain and Cleveland Counties, Oklahoma, carries a high pressure line of the Oklahoma Natural Gas Company.

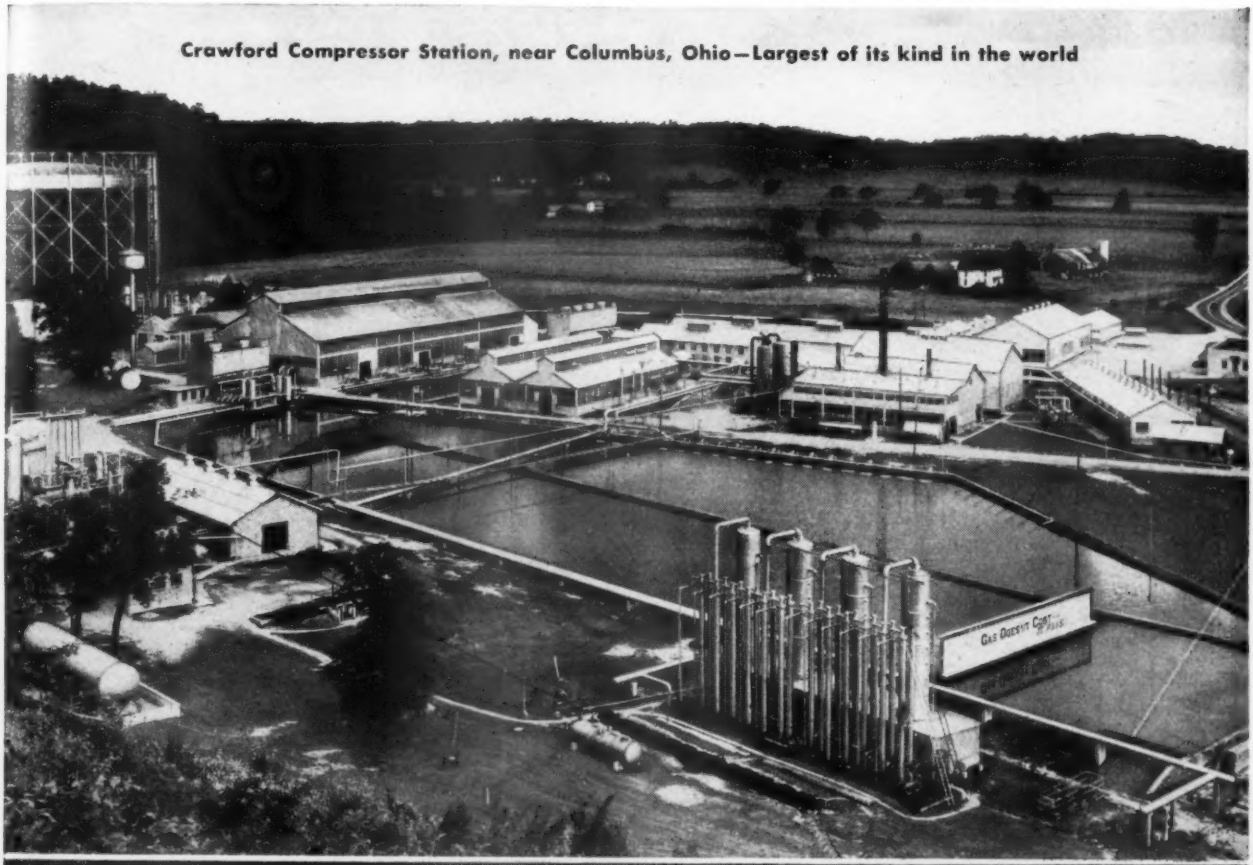
The main span, over the river proper, is 1760 feet in length, and the secondary span, over low ground that is considered the possible future river course, is 880 feet, while the over-all length of the bridge to the anchors on each side is 3698 feet. Pipe is supported a distance of 2640 feet. The width at the main towers is 190 feet.

The main towers extend 143 feet above the top of their foundations or piers, and the wind arms extend 77 feet from each side of the towers. The main tower caissons extend a maximum of 52 feet into the ground.

The bottom of the pipe is 32 feet above extreme high water level and 45 feet above normal level. It is supported by fourteen 1⅛ inch diameter cables and side braced against wind by one 2½ inch diameter cable on each side.

The line across the bridge is 12¾ inch, O.D. 41.51 pound, plain end, seamless line pipe, solid welded.

Under full flow, the working pressure carried on the pipe at this point is 880 pounds per square inch.



Crawford Compressor Station, near Columbus, Ohio—Largest of its kind in the world

☆ ☆ FUEL FOR WAR ☆ ☆

In the year 1943 Columbia System threw all its energies into the war effort. Output of gas and electric energy reached all-time high marks. Half the electricity and 39% of the gas sold by Columbia went into war industry.

Dependable natural gas as a fuel was supplied by the System to over a million industries, commercial consumers and homes. In addition, Columbia filled the electric heat, light and power requirements of more than 400,000 customers.

Columbia's operations extend throughout more than 1600 communities, serving a population in excess of 5,000,000.

In a very real sense, Columbia System is a publicly owned enterprise. It is responsible to 82,000 shareholders, living in all 48 states, 5 domestic possessions and many foreign countries.

Columbia System's 1943 gas sales . . . 187,280,477 Mcf; electric sales 1943 totaled 2,527,846,255 Kwh

COLUMBIA GAS & ELECTRIC CORPORATION

COLUMBIA SYSTEM

Transmission Lines of California

San Francisco obtains its natural gas from the Kettleman Hills fields through the transmission system of the Pacific Gas & Electric Company, while Los Angeles obtains its supply from the pipeline of the Southern California Gas Company.

Sales of natural gas throughout the P. G. and E. system last year increased by 12 billion cubic feet, or 11.3 per cent, over 1942. The load for purely war activities now exceeds 27 billion cubic feet a year—27 billion over and above the requirements of approximately 700,000 regular customers. Furthermore, this figure does not include consumption by a large number of industrial plants that have been converted from other purposes to war production. Nor does it include consumption by many plants, such as canneries, that are continuing their regular operations but whose products are used in the war effort. Usage by military establishments in Northern and Central California tops 4 billion cubic feet a year.

The natural gas transmission pipeline turned over for the delivery of oil is the Stanpac line, so called because it was built and operated jointly by the Standard Oil Company of California, the Pacific Public Service Company and the Pacific Gas & Electric Company. It is 26 inches in diameter and its gas transmission capacity was 150 million cubic feet a day.

When the supply of natural gas from Kettleman Hills and other oil fields was curtailed because of the release of the Stanpac for oil deliveries it became necessary to draw greatly increased quantities of gas from the Rio Vista field, about 60 miles northeast of San Francisco. In contrast to Kettleman Hills gas, which is a by-product of oil production, Rio Vista gas is dry gas and in normal times could be left in the ground until needed for essential domestic and commercial service or kept as a reserve supply. This year, however, because of the war, there is being withdrawn from these reserves a total of 160 billion cubic feet — enough to supply 200,000 families for sixteen years.

To transmit the extra supply from Rio Vista, the field was further linked with P. G. and E.'s natural gas network by the construction of new pipelines with a capacity of 200 million cubic feet a day—50 million more than the capacity of the Stanpac line from Kettleman Hills. Since then the Rio Vista transmission facilities have been substantially enlarged and still more additions are planned.

The Consolidated Natural Gas Company's System

Another comprehensive natural gas organization is that of Consolidated Natural Gas Company. This company, a public utility holding company, began its independent operations as of December 15, 1943, with the distribution of its stock to 125,000 shareholders, this stock having been acquired from the Standard Oil Company of New Jersey, and representing the capital stock of five natural gas companies formerly owned by Standard, these companies being: The Peoples Natural Gas Company, Pittsburgh, Pennsylvania; the East Ohio Gas Company, Cleveland, Ohio; Hope Natural Gas Company, Clarksburg, West Virginia; the River Gas Company, Marietta, Ohio, and the New York State Natural Gas Corporation, Pittsburgh, Pennsylvania.

This system, the result of half a century of constructive growth, is one of the strongest integrated natural gas systems in the country. The four utilities operate exclusively in Pennsylvania, Ohio, and West Virginia, serving nearly six hundred communities, among them some important cities such as Pittsburgh, Greensburg, and Altoona, in Pennsylvania; Cleveland, Akron, and Canton in Ohio, and Clarksburg and Parkersburg in West Virginia. It is a homogeneous system, and highly efficient. Its sales of natural gas approximate 115 billion cubic feet a year, of which nearly half is domestic and commercial business. For the calendar year 1942 it had gross revenues of $56,123,465. It produced about a third of its own gas from 5,800 wholly owned wells, and purchases the balance. It operates 3,200 miles of main transmission lines, 5,600 miles of field lines, and 8,544 miles of distribution lines, served by eighty-eight compressor stations. The company's total investment in plant is in excess of $200,000,000.

Montana

Still another important natural gas transmission line is that of the Montana Power Company, owned outright by American Power & Light. This transmission system interconnects Helena, Anaconda, and Butte with the Cut Bank Field.

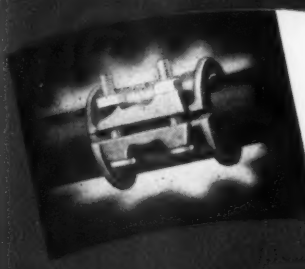
Betterment of Pipeline Technique

In the past few years, notable gains have been made in the technique of long distance transmission of natural gas. A decade ago, for example, there were few pipelines of more than 250 miles in length, whereas today some of the most recent lines are more than eleven hundred miles long, and those between five hundred and a thousand are common. Of course, the chief impetus behind the modern gas transmission line has been the demand of industry, especially in the Middle West, but this progress could never have been achieved if it had not been for the great technical advances that have been made in the art of pipe laying, both in the improvement of the materials employed and in general betterment of pipe line practice.

Installing Dresser (Style 41) Collar Leak Clamp on gas line in Ohio.

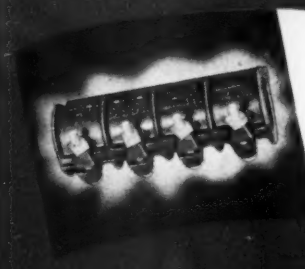
There have been only three important changes in pipeline practice in recent years. The first is that welded joints have become almost universal. Formerly, the pipe was fabricated in eighty to one hundred foot lengths, and then joined with Dresser type couplings, but with the approach of the late thirties there was a gradual but certain transition to the welding practice, especially in the case of large diameter pipe.

Dressler couplings are, however, used to join both steel and cast iron sections in both field and distribution systems, while in the sphere of industry they have thousands of applications.



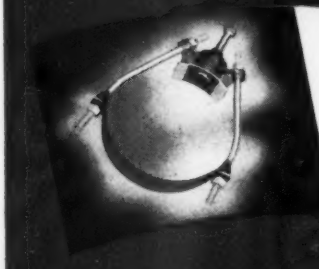
SKINNER-SEAL
EMERGENCY PIPE CLAMP

For stopping leaks in pipe lines, instantly, permanently. Pipe sizes 1/2" to 12". Standard for forty years.



SKINNER-SEAL
PIPE LINE CLAMP

For repairing long splits or very bad corrosion in pipe lines. Tremendously strong — for highest pressures.

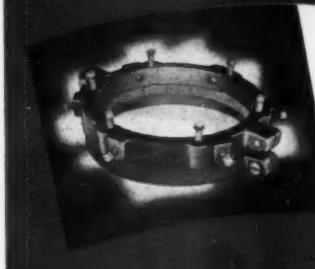


SKINNER-SEAL
VENTED PLUG CLAMP

For stopping leaks in extremely high-pressure pipe lines — safely. No chance of injury or damage.

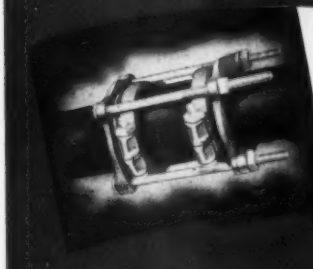
SKINNER-SEAL
PRESSED STEEL ECONOMY CLAMP

For repairing badly pitted and corroded pipe lines at minimum cost. A strong, dependable clamp.



SKINNER-SEAL
PIPE JOINT CLAMP

For stopping leaks at joints where pipe is screwed into a fitting. Without shutdown. Absolutely permanent.



SKINNER-SEAL
COLLAR LEAK CLAMP

For stopping every type of collar leak, regardless of kind of collar or condition of line. Extremely rugged construction.

6 WAYS TO SAVE PIPE

AND MAKE LASTING REPAIRS, TOO!

Right now, with the critical shortage of pipe, the SKINNER-SEAL method of repairing pipe leaks is invaluable. However, our shipping schedule is seriously upset on certain items. We would appreciate your anticipating your orders as much as humanly possible.

M. B. SKINNER CO.
Established 1898
SOUTH BEND, INDIANA, U.S.A.

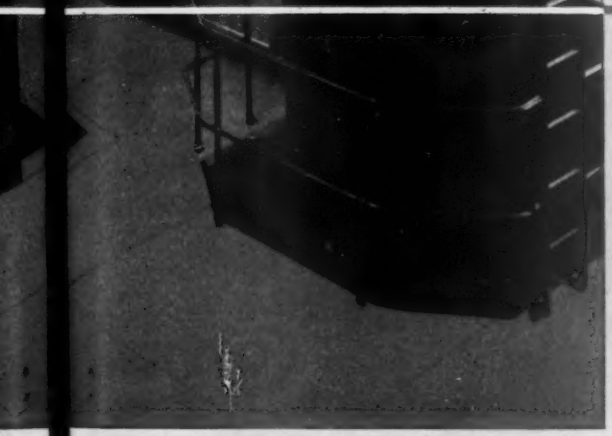
East Ohio Gas Company has recently completed the final project in a vast expansion program to meet the mounting gas requirements of Ohio war industry. This is a 120-mile 20-inch pipe line which for the first time brings Texas-Kansas gas into the Ohio gas area, connecting at Maumee with the Panhandle Eastern line, from which it will take 50,000,000 cu. ft. of gas daily to meet increased demand requirements.

Surplus of this gas which occurs in periods of minimum demand will be repressured and pumped to storage wells by Robinson Station here pictured. It is powered with five 600 H. P.

CLARK BROS. CO., Inc.

OLEAN, NEW YORK

Export Office: 30 Rockefeller Plaza, New York. Domestic Sales Offices and Warehouses: Tulsa, Okla.; Houston, Texas; Chicago, Ill. (122 S. Michigan Ave.); Boston, Mass. (Park Square Bldg.); Huntington Park, Calif. (5715 Bicket St.). Foreign Offices: London, England; Avda Roque Saenz Pena, 832, Buenos Aires.



3,000 H.P.

of CLARK "ANGLES"

Power East Ohio Gas Company's New Robinson Station

PANORAMA OF ROBINSON STATION

CLARK "Super-2-Cycle Angles." This is a unique two-function station. In summer it will pump the main-line gas into underground storage. In winter its high-pressure 2-stage cylinders are exchanged for low pressure cylinders, and the plant becomes a booster station capable of handling 200,000,000 cu. ft. of gas daily. Being designed for both pressures, this station has many unusual features.

Clark engineers have had years of experience in solving the world's most complex gas compression problems. Consult with them about your plans.

REAR VIEW OF COMPRESSORS
ROBINSON STATION

CLARK

One of the Dresser Industries

. . . when NO-OX-ID men thought first of service regardless of how little NO-OX-ID you bought?

Twenty-five years ago when corrosion on pipe lines presented very much of an unsolved problem, NO-OX-ID was new. Some bold souls tried it. A few pounds were ordered. And Dearborn men followed the shipments to see that it was applied properly. It looked promising . . . other petroleum and gas men heard about it and ordered trial quantities. Dearborn men kept following the shipments to give needed application assistance. A short time later NO-OX-IDized Wrapper became available, and again Dearborn men traveled with the shipment to see that it was applied properly.

Two reasons motivated this traveling of men to help apply NO-OX-ID . . . first, Dearborn, even at that time, had been built on abundant service; second, we had faith in the product and determined to build the best protection material money could buy. It did not make any difference how much or how little NO-OX-ID was bought . . . the customer was entitled to Dearborn service. Along came the war and NO-OX-ID products were first in the field of military packaging materials to protect vital replacement parts and equipment in overseas shipment. *They were accepted on their performance in protecting steel underground.* Dearborn men diverted their attention to this new problem, and all they have learned about water vapor moisture barriers is in trust for you tomorrow.

Some NO-OX-ID and NO-OX-IDized Wrappers are again becoming available for critical pipe line construction. More will be available soon, but

. . . remember the service is still the same whether you buy a pound or a ton!

NO-OX-ID
IRON + OX = RUST
rust preventive
NO-OX-ID-IZED WRAPPER FOR PACKAGING

THE LEADER FOR 25 YEARS

DEARBORN CHEMICAL COMPANY, Dept. AM, 310 S. Michigan Ave., Chicago 4 • New York • Los Angeles • Toronto

Better Steel Brings Increased Pressures

A second improvement has been in the pipe itself, especially from the stress standpoint. When the Chicago line was constructed in 1930, for example, it had a stress of about 25,000 pounds to the square inch at maximum operating pressure. Prior to that time, the highest stresses had been 20,000 pounds, with 15,000 pounds more common. At the time, this was a distinct advance, and pointed to the future trend. The latest designs, although not yet in operation, contemplate stresses up to 35,000 pounds per square inch, which are made possible principally through better steel.

The improved pipe which is obtainable today has made possible greater economies in both the installation and operation of gas lines, and permits greater overall economies because better protection has resulted in much longer life for the lines. One of these has been the development, to the point of practical perfection, of what is known as the electrical method of cathodic protection, a protection known to the old pipe line men as electrical drainage.

Modern methods of applying protective coatings has made practical the use om thinner walls, reliance being placed on the coating to prevent corrosion rather than on the thickness of steel to delay penetration. Some methods of treating pipe lines to resist corrosion without coating of any kind have been developed in recent years, notably by the well-known engineering firm of Ford, Bacon & Davis, whose work in the domain of natural gas has been outstanding.

Town border gas measurement. Meters and regulators installed at city gate of Robstown, Texas.

The High Speed Compressors Arrive

The final change in practice has been the definite trend toward the high-speed vertical compressor in replacement to the low-speed horizontal one, which greatly lowers the cost of the pumping station.

The first compressors used in the natural gas industry were modifications of those used in the manufacture of steel. They were of the horizontal type, and difficult to operate, being heavy and cumbersome. Through the years, however, they underwent refinement and improvement, until they became highly efficient machines.

However, with the rapid development of the long-distance transmission line, new-type compressors became necessary, chiefly as a means of controlling capital investment, and the angle-type compressor, which has revolutionized pipe line practice, and opened to natural gas new horizons of possibility, was introduced. This was in 1937. The first installation was made by the Clark Bros.' Co., Inc., of Olean, N. Y., the largest builders of gas-engine driven engines in the world, and for many years a dominant factor in the field of natural gas transmission. In this installation, built for the Memphis Natural Gas Company, there was a battery of five compressors, all designed, with their auxiliaries, by the Clark Company.

Formerly, compressor stations were located from 100 to 200 miles apart, but this practice is considered uneconomical today because it involves the use of an unnecessary amount of steel in the construction of the pipe line. The chief objective of the pipe line operator is the maximum utility of the available pressure, and this can be achieved only through more numerous compressor stations able to increase the quantity of fuel that can be transmitted through a given diameter of pipe. To this end, the interspacing has been reduced from a maximum of 120 to a minimum of 30 miles.

Cotton Valley cycling and pressure maintenance plant, Webster Parish, La. Twelve Clark 600 B.H.P., 6 cylinder gas engine driven compressors are employed in the operation.

Natural Gas and the Central Power Station

The efficiency, cleanliness, and economy of natural gas are factors in its favor, but it must be admitted that the single deciding factor is overall cost, an advantage that influences many of the large central power stations that are located within a reasonable distance of a pipe line to employ gas as their chief source of fuel, with fuel oil or coal as their standby reserve. It is estimated that approximately 180 public utility plants are now using gas in the generation of electricity.

A number of great central stations have also been erected in the heart of the producing field, and their generated current is being distributed by high tension lines to large areas. Seventy-eight per cent of the entire fuel needs of the central stations of the Southwest are supplied by natural gas. For 1943, the utilization of natural gas—the generation of power is estimated by the American Gas Association at about 295 billion cubic feet, an increase over the previous year of 26.6 per cent, which also registered a 12 per cent gain over 1940. Ten years ago, total consumption for this purpose was less than 80 billion cubic feet.

Natural gas has been one of the chief factors in the marvelous growth of the Southwest. Without it, for example, it would have been impossible to have developed the so-called Plains Region of Texas to their present state of productivity, for it has been the gas-operated engine that has made the use of the shallow wells of this arid region feasible for irrigation. At the present time, by far the larger proportion of irrigated farms in the Plains Region, which covers approximately 14 counties of the Texas Panhandle, utilize natural gas in propelling the motors that drive their pumps, which, on an average, raise and distribute 1,200 to 1,400 gallons of water a minute. The trend in this sphere of activity has been toward lightweight motors of a very high speed.

To release oil for the fighting fronts, the Pacific Gas & Electric Co., burned 27 billion cubic feet of natural gas in its steam electric plants in 1943 and will burn about 62 billion cubic feet this year — a total of 89 billion in two years as compared with 73 billion in the thirteen years between the advent of natural gas in 1929 and the end of 1942. And every 6000 cubic feet mean a barrel of oil saved for the war effort.

The use of gas has been extended even to three huge steam electric plants that the company recently built at oil refineries in Contra Costa County with the express intention of burning oil furnished by the refineries. These three are located at the refineries of the Tide Water Associated Oil Company at Avon, the Union Oil Company at Oleum and the Shell Oil Company at Martinez. Besides, the refineries, themselves, have largely substituted gas for oil as fuel.

Incidentally, the 62 billion cubic feet to be used in the generating plants this year will be more than twice as much as the entire usage of all the 220,270 gas customers in the City and County of San Francisco during 1943.

Natural Gas and the Synthetic Rubber Program

One of the chief contributions that the natural gas industry is making to the war effort is unquestionably in the field of synthetic rubber production which, by the way is not really rubber at all, but a plastic.

None of these man-created synthetics possess all of the inherent attributes of the natural substance for which they are substitutes, although having reasonably comparable qualities. Natural rubber is superior in the qualities of resiliency and adaptability to processing, the artificial types are better in resistance to oils, organic solvents, and oxidation.

As is well known, of course, Japan now controls 95 per cent of the rubber supply of the world. Rubber production in 1941 approximated 1,675,000 tons, and of the total the United States imported 820,000 tons. Before the war at least 75 per cent of all the rubber used in this country was made into automobile and truck tires, but now it is nearly all being used in the production of materials of war. An idea of the importance of rubber to the war effort was given recently in a talk before the New York Chapter, American Institute of Chemists, by Harold I. Kramer, who gave the following statistics of rubber needs: Gas masks, two pounds; pneumatic rafts, 30 pounds; army trucks, 500 pounds; bulletproof gas tanks, 1,200 pounds; medium tanks, 1,730 pounds; 10-ton pontoon bridges 3,200 pounds, and 35,000 ton battleships, 150,000 pounds.

Extraordinary progress has been made in the synthetic rubber program, and shows how American industry can meet the challenge when given the opportunity. This well-conceived and far-flung effort to make this country, temporarily at least, independent of foreign supplies, does not contemplate the extinction of the natural article. Far from it, for the Government is doing its best to encourage the growing of rubber in Brazil—once the chief source of the world's supply—Mexico, and other countries to raise as much rubber as possible. It expects that the demand for this commodity will be continuous, and that far from being affected by the war a return to normal conditions will bring an increased demand, not alone in the United States, but throughout the world.

The so-called Baruch program calls for an ultimate production of more than a million tons of synthetic rubber a year, and that it will be produced, the tremendous progress already made is the guarantee. The cost of the creation of this great new chemical industry is estimated at approximately $650,000,000 but it would seem to be justified. John L. Collyer, for example, predicts a world consumption of rubber after the war, natural and synthetic, of at least 2,000,000 tons.

The petroleum industry is so closely related to that of natural gas, which is playing at least a part in the development of synthetic rubber, that it will be interested no doubt, in the statement of William M. Jeffers, Rubber Director, as to where a good portion of the credit for the success of the rubber program must be placed. It concerns a company which has been associated for years with the natural gas industry and whose president, R. W. Gallagher, has been one of the outstanding forces in its development.

"Had it not been for the research and engineering development carried on by the Standard Oil Company of New Jersey prior to Pearl Harbor," said Mr. Jeffers, "the synthetic rubber program would be one and a half years behind what it is now. This company has worked incessantly to promote not only the synthetic rubber and the aviation gasoline programs, but all the war efforts that come within its province."

THE BUREAU OF MINES—

A Vital Force in National Development

WHEN, in 1914, the scope of the Bureau of Mines, established in 1910 to meet the acute problems of the coal industry, was extended to embrace petroleum natural gas, it was not expected that this then inconspicuous branch of the Department of the Interior would grow to be such a mighty force in the economy of these two great industries as it has become.

Many and far-reaching have been the achievements of the Bureau of Mines in both the natural-gas and petroleum industries, and this highly efficient organization has consistently interpreted, in letter and in spirit, the platform set forth in 1933 by H. C. Fowler, now its assistant chief:

"It has been a motivating thought within the Bureau of Mines since its petroleum division became an officially recognized unit of the Bureau on July 1, 1914, that the chief function of that division is to develop and carry out a coordinated system of research projects pertaining to oil and gas. In performing this function, the best available knowledge and information regarding physical phenomena and other conditions are gathered together, and analyses are made of the data that help to explain the working out of definite laws and fundamental relationships. By the practical application of these relationships to oil and gas fields, pipe lines, and refineries, it is possible to produce oil and gas more rationally, transport them more efficiently, and manufacture them into useful products with less cost.

Roscoe A. Cattell, Chief of Oil and Gas Division, Bureau of Mines

"The Bureau has long recognized that there is a merging from fundamental research in the laboratory to so-called 'practical' research. Therefore, in developing the philosophy of any research project it is not enough to establish certain fundamental relationships by laboratory experiment: to be effective the work must have practical application in the field or at the plant.

"Through its publications, letters, formal papers, personal discussions, and other means of disseminating information, the Bureau also is slowly yet definitely helping to guide the public mind away from the erroneous ideas (evolved during the early life of the petroleum industry because of the fluid and mobile characteristics of oil and gas) to those on a more rational basis, that tend to conform more nearly with the unalterable laws of nature."

It is not to exaggerate to say that there is no problem affecting these two great natural resources which the scientists and technicians of the Bureau have not at some time investigated. Naturally, all problems cannot be instantaneously solved, for not infrequently they involve continuous research and experiment over periods of years, but ultimately they are satisfactorily unraveled or placed on the agenda of unfinished work. Abandonment of any problem is something unheard of in the Bureau of Mines.

From the day of its foundation, the Petroleum and Natural Gas Division of the Bureau of Mines has been the fountain-head from which streams of practical knowledge have flowed to the vast benefit of both of these industries. It has been the chief single thought of the many fundamental engineering investigations that have been conducted in the spheres of oil and natural gas during the past two decades, during which time its scientists and technicians have worked

Dr. R. R. Sayers, Director
U. S. Bureau of Mines

Photo courtesy Bureau of Mines, Department of the Interior

incessantly to bring down light upon many of the most intricate problems with which these industries have been faced.

Innumerable and varied in complexity have been the problems in the natural-gas industry that the technologists in the Bureau of Mines have conquered. There was, for example, that very important problem of leakage from gas-pipe lines, whose solution has had such beneficent and far-reaching effect, especially in the conservation of natural gas. There were the studies, no less important, of the solubility of natural gas in crude oil, which resulted in a more economical utilization of the inherent energy in the oil. Equally outstanding, was the development of the back-pressure method of testing the capacity of natural-gas wells, which resulted directly in the saving of untold millions of cubic feet of natural gas a day, and in the protection of the wells themselves, which formerly were subject to great damage, not infrequently beyond repair. For example, 221 wells in the Texas Panhandle would have vented 115 million cubic feet of natural gas in less than an hour if they had been blown in the ordinary way. As a direct result of the Bureau's innovation, virtually every important natural-gas transmis-

sion line is periodically tested for leakage, so that loss is kept to a virtual minimum. It is interesting to record that the Bureau's back-pressure method of testing has become the universal practice, prescribed as mandatory by the conservation departments of many states.

The Bureau of Mines has expanded its research program and its energies to cover all phases of the war effort, especially in furnishing technical information that has made it possible to produce on a hitherto uncontemplated scale improved oils, gasolines, and condensates. Especially has research been speeded up on aviation gasoline, including both natural and synthetic components. The Bureau has concerned itself also with the synthetic rubber program, particularly through its studies of the thermodynamics of hydrocarbons and their derivatives.

At the request of the Petroleum Administration for War, the Bureau is carrying on at the present time, from the Dallas Office and from Washington, extensive studies of condensate natural-gas reservoirs in Texas and Louisiana to determine the quality, nature, and reserves of the components of the reservoir fluid that may be utilized in the production of aviation gasoline. In this connection, the Bureau has designed and constructed a portable laboratory for use at the wellhead for testing condensate-bearing gas. Of course, in the reservoir the gas exists in a volatile state, and ordinarily would be transformed to a liquid condition on the reduction of pressure, which, in the reservoir, would be wasteful. The concern of the Bureau's engineers, therefore, is to determine at what pressure in the reservoir this retrograde phenomenon occurs, so as to prevent the condensation of the valuable hydrocarbons before the gas reaches the surface.

Petroleum Experiment Station, Bartlesville, Okla.

Photo courtesy Bureau of Mines, Department of the Interior

Conspicuous as has been the role of the Bureau of Mines in the sphere of natural gas, no less significant and effective has been its achievement in the petroleum industry, particularly in the broad scope and general excellence, of its engineering studies of the major oil fields. It is impossible, indeed, to translate into monetary terms the accumulative value to the industry and to the nation of the sterling work of the Bureau in this respect. One of the greatest of the myriad of problems that have found successful solution in the studies of the Bureau of Mines, is that of crude oil evaporation in storage. It was wholly as a result of the studies made in Washington, D. C., and in Bartlesville, Oklahoma, that the industry was first awakened to the great waste of gas that the then common practices involved, and inspired to take the necessary measures for their correction.

The Bureau of Mines collaborates at all times with state regulatory and other government bodies, with technical societies and scientific organizations, and with individual companies of all kinds and in all fields of endeavor, irrespective of size or importance. It is willing, and anxious, also, to help in any manner possible, consistent with good practice, in promoting the interests of the oil and natural gas utilities.

Especially is it desirous to take up for them the more intricate problems that are sometimes beyond their ken and scope. This willingness to collaborate does not merely apply to the great utilities and the larger companies, for the smallest producer can invoke at any time the cooperation of these men of science with the assurance that they will receive sympathetic hearing and whole-hearted cooperation. It is unfortunate that many of the smaller operators fail to realize that the Bureau of Mines is composed of men who are in this work for the sheer love of it, and that their services are part and portion of the benefits of our type of government, free to all.

In this connection, it should not be overlooked that the men who toil in the Bureau of Mines and other similar governmental organizations, working incessantly for the public weal, could obtain infinitely greater remuneration in other spheres of endeavor if their sense of obligation to national trust were less acute. Nowhere in the world, perhaps, can be found more efficient or more conscientious workers than the men in the service of the United States Government, such as these technicians of the Bureau of Mines, who, unfortunately, receive little public recognition, and, generally speaking, are inadequately compensated.

The Great Carbon Black Industry

APPROXIMATELY fifteen per cent of all natural gas produced in the United States is utilized in the manufacture of carbon black. Little is known by the average layman about this substance which is absolutely indispensable to the economic scheme, and especially so in these strenuous days of war.

Without carbon black, indeed the modern automobile would not be able to function at all, for approximately four and a half pounds of it is used in every four-ply passenger tire made. Larger tires for heavy duty military and civilian trucks, busses, airplanes and military mobile combat equipment require considerably more black, the amount depending, of course, on the size and the number of plies.

In tire manufacture, for example, if carbon black were left out of the rubber 4,000 miles instead of 35,000 to 40,000 would represent the average life of a tire. This is because carbon black adds strength and toughness to the rubber, making it more resistant to wear. This will be understood when it is stated that the ultimate particles of carbon black are infinitely small—less than a half a millionth of an inch in size. So small, indeed, are they that until the invention of the electron microscope it was impossible to distinguish them, for to the naked eye they present only a conglomerate mass. In texture, they are soft, and thus readily fill the interstices of the rubber and give it the added strength.

Because of its jet black color, soft texture, and minute subdivision, carbon black is also of primary importance in the manufacture of printing inks of every kind, ranging from the cheapest newsprint ink to the highest-grade half tone products. A pound of newsprint ink contains 10 to 12 per cent carbon black, and the percentage increases with the qual- until the very best lithographic ts, which contain, on the average, out 30 per cent.

Carbon black finds application, also, innumerable other industrial prac- es, such as in the manufacture of nts, lacquers, enamels, shoe and ve polishes, phonograph records, ewriter ribbons, carbon paper, in ling wax and crayons, in molded stics, in confections, in the color- of cement and concrete roads, in tilizers, as an aid in the grinding Portland cement, in explosives for mining purposes, as a filtering medium for purification purposes, and in the manufacture of metallic carbides. Carbon black, through improving the dielectric properties of cable insulation and insulation oil, is of importance also in the communications field.

A patent for making carbon black from natural gas was granted to John Howarth, of Salem, Mass., in 1872, and the first commercial plant for its recovery was built at New Cumberland, West Virginia, in the same year, but more than a half century was to elapse before carbon black manufacture was to become a factor of importance in the national life.

Practically the entire carbon black supply of the world is produced within the borders of the United States, and nearly 90 per cent of it is consumed by the rubber industry. Prior to 1912, in which year the inherent qualities of carbon black as a reinforcing agent were discovered, the substance was used for coloring purposes only. It is interesting to note that the use of carbon black in the manufacture of every type of reinforced rubber is now mandatory. It is not to exaggerate, indeed, to state that the great rubber industry that has been erected in America would not be in a position to function at all without it.

Carbon black is manufactured under three radically different processes, each yielding distinct types of black. These processes are:

1. The channel process, in which fan-shaped smoky flames—produced by burning natural gas in a limited supply of air through small lava tips —are impinged upon moving iron channels on which the carbon black is deposited, and later automatically scraped off.

2. The partial combustion of natural gas in especially designed furnaces in which the carbon black is separated from the gaseous stream by electrical precipitators. These precipitators, equipped with a battery of cyclone collectors, operate at exceedingly high voltages.

3. The thermal decomposition of natural gas in brick checker-work furnaces, under a cyclic process, requiring the heating of the brick with a mixture of natural gas and air, followed by another treatment of natural gas alone. This results in the decomposition, as a result of the heat, of the natural gas into carbon black and hydrogen. The resultant carbon black is then cooled by sprays of water, and separated from the gaseous stream by what is known as the bag filter system. Sometimes the hydrogen is utilized in the synthesis of other products.

In the early days of the industry, there was relatively little demand for natural gas, and it was readily available for carbon black manufacture. However, as domestic and industrial markets for the fuel were created the carbon black producers had to seek new fields of operation. Thus, in succession, the industry migrated in the 80's from Pennsylvania to Ohio, and approximately ten years later from that state to West Virginia, which for a quarter of a century produced practically all the carbon black made in the world, reaching a peak production of 30 million pounds in 1919.

In 1917, the industry again migrated, this time to Louisiana, where the great Monroe Gas Field had recently been discovered, providing industry with a supply of five trillion cubic feet of natural gas.

In the early days of the Monroe Gas Field, the manufacture of carbon black constituted practically the only market, and, because of this, such thriving communities as Monroe and Bastrop, may be said to have been founded with a substructure of carbon black, for literally millions of dollars were invested in this industry in the early days of the field, providing not only an immediate and remunerative market for the producers, but acting as a lodestone in attracting utilities and industries to North Louisiana.

A decade after the Louisiana migration, with the discovery of the great gas reserves of the Texas Panhandle, the carbon black industry commenced to operate in that state, which gradually assumed leadership, until today it is in a preponderant position, producing 90 per cent of all channel black made and at least 75 per cent of the country's total.

Other states participating to a small degree in the manufacture of channel process carbon black in the past quarter of a century have been Montana, Utah, Colorado, Kentucky, and Oklahoma. Today, only Louisiana, Texas, and New Mexico are producing carbon black by the channel process, the last-named state having come into production only recently. Kansas, also, is manufacturing some carbon black under the roller system, in which candle-like flames impinge

on iron cylinders instead of on channels.

Until ten years ago, practically all carbon black produced was made by the channel process, and it was not until the early 20's that production by the furnace process was commenced. This was in Louisiana. Progress was relatively slow, so that by 1937 only about 8 per cent of the carbon black produced was made by the furnace method. However, in the past five years it has become increasingly important, contributing 14 per cent of the total in 1940, 24 per cent in 1942, and 38 per cent last year. It is estimated that production under this process during the present year will represent 45 per cent of all the carbon black made in the country.

Carbon blacks are now being produced by the furnace process in Louisiana, Texas, Kansas, Oklahoma, and California, the present rate of production aggregating about 378 million pounds annually, and of this total Louisiana is producing 40 per cent, Texas 24 per cent, Kansas 17 per cent, Oklahoma 14 per cent, and California 5 per cent.

Half a century ago, in the early days of the industry, carbon black manufacture had total annual production of only a million pounds, and at the turn of the century only six and a half million pounds. With the development of the great automobile industry, carbon black production grew apace, as the following figures show:

Carbon Black Production, Pounds	
1925	177,000,000
1930	379,000,000
1940	569,000,000
1943	603,000,000

It is expected that production this year will approach 800 million pounds, just about sufficient to meet the intensified demands that all-out war has brought.

Approximately 369 billion feet of natural gas were used in the manufacture of carbon black in 1940; 365 billion in 1941, and 336 billion in 1942. The 1943 figures, of course, are not yet available, but they are expected to reflect the recent trend of more carbon black from less gas.

The recovery of carbon black from natural gas averages about one and a half pounds per thousand cubic feet under the channel process, but under the furnace process is approximately from three to nine times as great, depending upon both the richness of the gas and the character of the black to be produced. This increase in production per thousand cubic feet of natural gas burned is playing a notable role in the conservation of this resource and constitutes a tribute to the efficiency and vision of the carbon black industry.

At the present time there is a total inhibition in many states on the use of natural gas for the production of carbon black, and even where its utilization is permitted, production is rigidly controlled. In the vast Panhandle Field of Texas, for example, with its practically limitless resources of this greatest of all fuels, the Texas Legislature authorizes the manufacture of carbon black by the channel process from waste gases only such as sour gas contaminated with hydrogen sulfide and other sulphurous elements and casinghead gas produced from oil wells along with the oil. In one locality, namely the Panhandle, the Texas Legislature allows sweet gas, that is to say gas which would be available for pipe line purposes to be used for the manufacture of furnace black where the recovery is five pounds or more per one thousand cubic feet. This permission, however, applies only to sweet gas produced from a field which also produces sour gas.

In the adjoining table, compiled by the Petroleum Economics Division, United States Bureau of Mines, are set forth the chief statistics of the carbon black industry for the years 1941-1942:

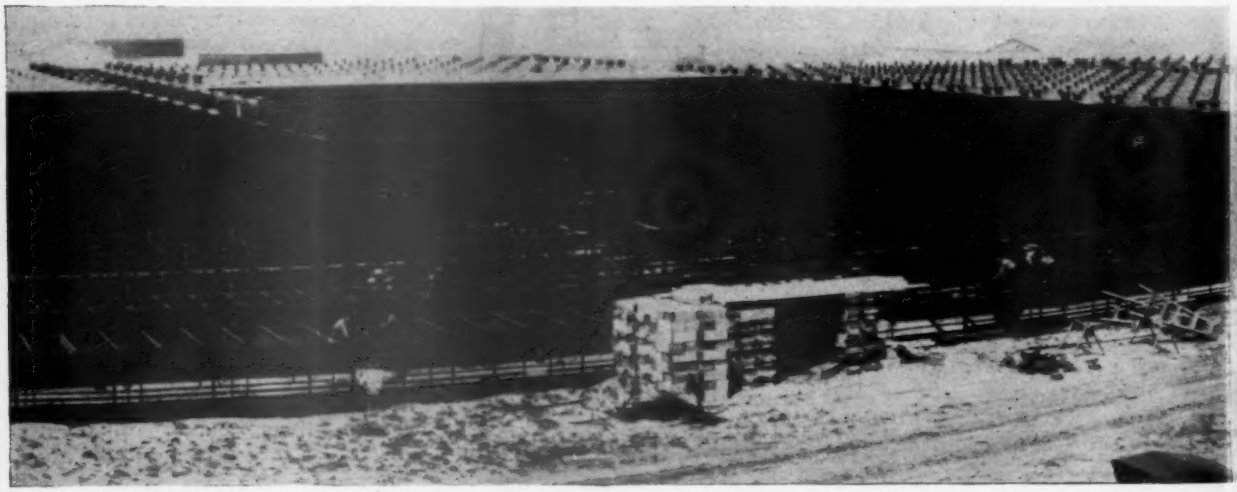
According to authoritative sources, the production of carbon black in 1943 amounted to 603,000,000 pounds, of which about 380,000,000 were channel blacks and the remainder furnace and thermal blacks. This carbon black had an average value of less than five cents a pound. Contrast this modest figure with that of the first recorded commercial sale of the product in 1872, in West Virginia, when it brought exactly $2.50 a pound. Even twenty years ago, carbon black had spot value of 8½ cents a pound.

In this connection, it may be said that, with gas and electricity, carbon black is one of the few commodities which have become progressively cheaper through increased production.

Normally, thirty per cent of the carbon black produced is exported, chiefly to Great Britain, its dominions and dependencies, but in a measure also, to many other countries, including Germany and Japan, now believed to be obtaining their needs of this material from various organic materials capable of gasification. Russia, in prewar days took little American carbon black, which leads to the assumption that she was manu-

ACRES OF STEEL

Partial view of the Borger, Texas, Carbon Black plant while under construction. This plant contains 43 miles of steel channels and 600,000 burning tips. It consumes over 40 million cubic feet of natural gas per day in carbon black production.



1941-1942 Statistics of Industry

Plants and Production

	1941	1942
Manufacturers	21	21
Plants	49	50
Texas Panhandle	415,001,000	380,536,000
Other Texas	65,211,000	54,353,000
Total Texas	480,212,000	434,889,000
Louisiana	78,050,000	90,353,000
Other states	35,803,000	48,764,000
Total United States	594,065,000	574,006,000

Distribution of Sales

Rubber companies	439,502,000	295,947,000
Ink companies	28,198,000	19,233,000
Paint companies	5,840,000	3,616,000
Miscellaneous	58,469,000*	131,135,000*
Exports	112,735,000*	— —
Total sales	644,744,000	449,931,000

* *October, November, December 1941 exports included in miscellaneous, as are all 1942 export sales.*

Natural gas consumed	365,377,000 mcf	335,533,000 mcf
Average yield per Mcf	1.63 pounds	1.71 pounds

facturing her own, probably from natural gas produced in the Caucasian oil fields.

However, carbon black shipments are now going to Russia through lend-lease arrangements. Shipments are likewise going to the British Empire and certain Latin American countries. These countries, with Russia, are now the carbon black industry's only export customers. What peace may have in store is problematical.

The subject of carbon black in current rubber development is a matter of considerable importance. Carbon black continues to be the best reinforcing medium for Buna-S, the most important of synthetic rubbers. Also, it strengthens Buna S to a greater degree than it does natural rubber. For instance, normal loadings of carbon black, such as are used for tire treads, will in the case of Buna-S increase the tensile strength of the stock 1200 per cent, whereas in natural rubber, with the same amount of carbon black employed the tensile strength is increased by only 50 per cent. Similarly, the hardness of Buna-S rubber is increased by 80 per cent, whereas the increase in hardness of the natural product is 60 per cent.

The main differences between synthetic and natural rubber are those of processing, reinforcement, resiliency, and heat generation. Buna-S is relatively harder to process than natural rubber. It lacks reinforcement by itself, is not as resilient, and when subjected to heavy loads and high speed has a tendency to heat up excessively.

It was early accepted that until the quality of Buna-S had been improved to a point where it would be equal to or better in every respect than the crude natural rubber it was replacing, it would be necessary to employ different types of carbon black from those generally employed with the natural material. Accordingly, arrangements were consummated for the expansion of existing plants to enable them to produce these special types of carbon blacks, requiring the solution of various problems of processing, resiliency, and heat generation. The result has been the production of improved types of black that have met every demand made upon them. The carbon industry has been alive to the emergency, and has given unstinted cooperation to both government agencies and the rubber industry. According to Progress Report No. 5, published under date of March 17th, Bradley Dewey, Rubber Director, states that this expansion has involved the construction of 17 new projects. Patriotism rather than sound business acumen has been the motive that has inspired the carbon black industry so greatly to expand its war-time operations. When hostilities cease, peace and a return to normalcy will come. What, then, will be the attitude of government toward the industry which has so increased its productive capacity to fulfill the requirements of the armed forces?

As may be seen, the rapid expansion in the production of furnace carbon blacks in recent years is attributable very largely to the synthetic rubber program, in which they play such an important part because they can be used in much greater loadings than the channel blacks. They are not as highly reinforcing as the latter, but they have much better resiliency, and they generate less heat.

Furnace-type blacks are of particular value in the body and sub-treads of a tire where low heat generation is a critical need, as also in certain other automotive rubber parts.

As is generally known, the Government's synthetic rubber program has exceeded the most sanguine expectations. It is not unreasonable to say that at least a portion of the credit must be given to carbon black, whose role, as we have shown, is of far-reaching importance, and promises to be even more so in the future. Intensive research and experiment on the part of the carbon black manufacturers, with their splendidly equipped laboratories and army of scientists and technicians, have resulted in great improvement of channel blacks, and this without detracting from their inherent characteristics, such as reinforcing qualities and resiliency. A feature of this improvement has been a material increase in the processing ability of the blacks, and a material reduction in their tendency to generate heat. This achievement is particularly noteworthy because under present practices such large amounts of certain hydrocarbons are extracted that the carbon black manufacturer is compelled to work with the leanest kind of gas.

The large production of furnace process blacks obtained from the new facilities has not reduced the needs for channel blacks. In fact the demand for channel black by the end of this year is expected to exceed the requirements of pre-war days.

One of the recent improved channel blacks, known as the "easy processing carbon black," has been found absolutely necessary in the manufacture of large synthetic tires that are required to withstand heat, especially those for heavy military and civilian bus and truck duty. It is anticipated that this improved type will constitute at lease 80 per cent of the future channel black demand.

Carbon black is playing an important role in the war effort. Without it, the great synthetic rubber program would have been impossible of achievement. It is being employed in a large way, also, in the manufacture of war supplies, such as rubber clothing, shoes, bullet sealing fuel cells, footwear for the Army and Navy, soles, heels, hose and tubing, life rafts, boats, wire, cables and various mechanical goods. It is helping also to provide tires for jeeps, trucks, Flying Fortresses and other fighting equipment, and is also being used in the manufacture of blackout materials and as an agent in reducing glare on airport runways.

As to the status of the carbon black industry in the post war period, all indications point to an increased need for the material, according to Mr. Harvey Firestone, Jr., as outlined in the March 4, issue of "The Saturday Evening Post."

"For the first year or two after the war ends, the world will need every pound of synthetic and natural rubber that can possibly be produced. It is estimated that the automobile industry will turn out no less than 4,500,000 new cars during the first twelve months of peace. Four and a half million new cars will take 22,500,000 new tires. And during this same critical twelve months we shall need some 55,000,000 more new tires to replace the worn-out tires on some 15,000,000 to 20,000,000 old passenger cars and trucks. That adds up to about 77,500,000 new tires for this country alone. The most tires the industry ever built in recent pre-war years in America was 61,540,000 in 1941.

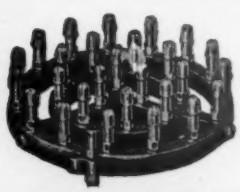
"Now let's look at the rest of the world for a moment. The British Isles, all of Europe, most of Asia and part of Africa will have to be rehabilitated. Many nations will probably embark on a building boom that will include millions of new trucks and cars. All of these must have tires. Every continent will require rubber products in quantities far beyond any previous needs.

"There are conservative rubber economists who believe that the world will need as much as 1,850,000 tons of natural and synthetic rubber annually during the first few post war years. In the last three pre-war years, we in the United States used an average of 670,000 tons of natural rubber. The rest of the world used possibly half that amount, making a total of around 1,000,000 tons of natural rubber each year. Yet, the moment peace comes, there will be a call for nearly twice that amount of rubber each year for several years. This means that basic rubber production will have to be nearly doubled in comparison with recent pre war years."

An analysis by another top executive of a major rubber company concludes that world production of rubber in the first post-war year will increase at least 400,000 tons, or from 1,100,000 tons in 1939 to 1,500,000 in the first peace year. This well-informed executive believes that within ten years after the cessation of hostilities consumption may surpass 2,000,000 tons.

As with rubber, so it will be with carbon black, for the one cannot expand without the other. For twenty-five years now the dependency of the rubber industry on a continual supply of this commodity has been a factor that has contributed to the upbuilding and prosperity of both these important industries. Certainly, it may be expected that, led by forward-looking executives, men of vision and achievement, the carbon black industry will rise to the heights of opportunity to meet the utmost demands of American business.

BARBER BURNERS
For All Gas Appliances



Today, the *fuel* economy of Barber Burners is appreciated as never before. Our factory production is now partially devoted to vital parts for combat equipment. Subject to Federal restrictions, Barber Burners and Regulators are still available. Plan NOW for big post-war appliance business. Barber engineers will cooperate on your design problems.

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For the past 25 years it has played an increasingly important role in the expansion of the tire industry because of its ability to reinforce rubber. It is a vital factor in our war effort to provide necessary and suitable rubber for fighting equipment, such as tires for planes, combat trucks and cars, rubber for life rafts and landing boats, rubber for bullet sealing tanks and electrical insulation—rubber for a thousand and one victory needs. Carbon black has been a life saver for synthetic rubber for it supplies the needed strength. Thus, natural gas, carbon black and rubber go hand in hand in promoting our national welfare and helping to bring victory ever closer.

UNITED CARBON CO., INC.

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The Service Department's Stake in the Development of Post-War Gas Appliances

By

J. M. Pickford

Northern Indiana Public Service Co.
Hammond, Ind.

THERE IS A GENERAL feeling among the members of the Distribution Committee's subcommittee on "Work on Customers' Premises" that appliance servicing costs can be reduced chiefly as the result of improved appliance design. Better installation methods improved gas quality, and in some instances, improved employee training methods and reductions in the amount of "gold plating" in the type of service rendered our customers. Quite a few of the members feel, too, that designers of appliances have not considered sufficiently the effects of streamlining, of decreased flexibilities and of automatic control upon the Service Departments' problems.

At this point we wish to inject the thought that none of the foregoing or following be taken to imply that gas appliances are prone to cause service problems. A real analysis will reveal the opposite. Gas appliances hold up remarkably well. Because the service department only comes in contact with the trouble makers, we naturally are inclined to point out faults on appliance and installation method. There are many others that do not cause any trouble. A large number of appliances are not serviced in years. In fact, a management member of our company stated to me that perhaps we should investigate appliances that have not been serviced in a certain period of years. I had discussed with him the average period per customer for adjusting burners.

In this introduction, we servicemen wish to bring out another point. We realize the necessity for increased efficiency, for streamlining, and for automatic control, and we realize that it is better to have servicing problems and modernization than the old type appliances with less servicing. This is fully emphasized by experience with the CP range. You remember how many of us went along 100% with this development. You remember how we offered suggestions to designers and service supervisors for improvements so as to reduce servicing expenses.

Presented at American Gas Association, Technical Section, 21st Annual Distribution Conference, Hotel Statler, Cleveland, Ohio, April 18-19, 1944.

In searching about for some way in which it could turn its efforts into constructive channels, find some medium by which field experience could be collected, analyzed and used as a guide in making suggestions intended to eliminate or avoid troublesome servicing problems, the customers' premises committee became much interested in the activities and objectives of the American Gas Association's Committee on Domestic Gas Appliance Research. The Conference on Domestic Gas Appliance Research held in this same hotel last February gave us a key to the manner in which we as a group could pass along to Mr. Boothby's committee, to the manufacturers and to the Testing Laboratories Approval Requirements Committees a more comprehensive picture of how appliances are performing in the field, where and why they need the service man's attention. We know that these agencies will welcome whatever information and recommendations we pass along to them as a manifest of our desire to assist them in attaining a common objective: the development of appliances which will be highly pleasing to look upon, yet easily accessible for adjustment; fully automatic yet safe and positive in their operation; durable in their construction, yet cheaper to build and sell; more efficient yet flexible enough to operate satisfactorily on average gases and distribution systems.

Much has already been accomplished toward the attainment of these objectives but those of us who come in everyday contact with the serviceman and his work are somewhat apprehensive about the future. In the highly competitive boom market for gas appliances after the war the sales departments of our companies will be in the ascendancy and there is the probability that those features inherent in the appliances which are now contributing to the service department's difficulties will be continued and that those features which are likely to be added as the result of research now in progress may accentuate servicing problems.

Since we in the servicing end of our business are the people who have to live with and maintain in satisfactory operating condition the appliances sold by our sales departments —and by our dealers—we believe we are entitled to a hearing in any plans being made by our industry for their improvement. We believe that we will be given a hearing and that if we can present to the proper people a comprehensive but detailed and specific analysis of the things we hope to overcome and to improve, we shall be listened to and our recommendations carefully weighed. But the weight given should be in proportion to the soundness of our reasons and the array of evidence to back them up. We have a number of things to do preparatory to presenting our facts and our suggestions. This is where you come in.

We as a committee hope to gather information on field performance of domestic appliances and from it make recommendations on improvements which would reduce the need for service and facilitate servicing where it is required. But any information we collect must be factual and specific and it must be of the kind needed for our purpose. Many of you gathered here are vitally concerned with and interested in your own service departments. We would very much appreciate your cooperation and welcome your assistance in furthering the objectives of our committee.

One of the most effective ways in which you and I as utility representatives can bring about needed improvements in appliances is by bringing our recommendation to the appropriate Approval Requirements Committee of the Testing Laboratories. Many of us are members of those committees, but anyone who is not, need only write a letter to Mr. Conner, Director of the Testing Laboratories, or to the Chairman of the committee having jurisdiction, setting forth his difficulties and recommendations. There is a separate committee for each appliance, its membership consisting of utility men and manufacturers in equal numbers. All communications received between

meetings and all ideas presented by committee members are given careful consideration. If convincing evidence is presented that a certain appliance or accessory is giving trouble in the field and the trouble can be remedied by a change in the requirements under which it was built and approved, the committee revises the requirement if possible. The thing to remember is, however, that considerable weight of evidence is needed to indicate that the failure is due to faulty design and not to poor installation or gas service. In this connection I should like to discuss the sort of facts needed and how they may be obtained.

Most of you undoubtedly prepare for your own Company's information periodic reports showing the number of service calls, the purpose for which each call was made, the character of the trouble found, what was done to remedy it, the kind of appliance involved, etc. But because these reports are usually made for the Management in order that it may analyze the trends of servicing costs, they do not include the sort of factual data needed to enable the service supervisor, the manufacturer, the designer or the research man to put his finger on the weaknesses in design causing failures or those things which take up the service man's time in adjusting an appliance. Unless such data are known it would not be fair to attribute all the service calls to poor or faulty appliance design. Perhaps the majority of gas companies have such information on the service man's report or elsewhere, but, if not, each of us should seriously consider the costs involved in obtaining such data and then weigh those costs against the advantages to be gained by assembling and clearing them through channels which can perhaps use them to advantage in producing better appliances.

In analyzing service reports we must be careful to differentiate between those failures which are due to defects in appliance design, workmanship or material and those due to improper installation or other causes due to the gas. To illustrate what I am talking about let me use as an example an Analysis of Gas Service Work in one Company. It covers the kind of appliance but not the model number of the manufacturer; it covers pilots, burners, controls and thermostats but, again, it does not show the model nor the manufacturer. It shows the number of pilot failures but not the number that were due to faulty design. It shows the number of burners adjusted and cleaned but fails to show why such adjusting and cleaning was necessary. It includes bill inquiries, and costs per call and per customer. All of this information is very valuable but not of the type needed for our purpose here. There are companies who are gathering the desired information and at least one company I know of has used the "How has the appliance performed in the home" angle in helping to shape its postwar merchandising plans. We think this is a good approach to use because it provides the opportunity of finding out whether the customer has based his opinion of a particular gas appliance on its appearance, on its convenience or on its performance. I think it is important that we know all these things when trying to make up our minds what the customer likes in the way of domestic gas appliances. The accompanying sample service order has a number of items that might be helpful in this kind of analysis.

I do not want to leave with you the impression that the majority of gas appliances on your lines and ours are not giving service satisfactory to our customers; we know this is not the case. If I may refer to our own experience, only 1¼% of all ranges on our system were "cleaned and adjusted" in 1943. Only 4.4% of the range pilots needed attention. This is assuming that each of our customers has a gas range. And much the same good record can be claimed for other appliances. Our experience is probably average and we may, therefore, assume that the record of performance throughout the country is equally good. Why then, one may ask, do we appear so concerned about the effect of research and design upon the future performance of appliances? The answer I think is to be found in the records of many gas companies who keep detailed records of servicing costs, such as I have mentioned. In general, the trend of

CUSTOMER'S TICKET - GAS

Name.....

Address.....

Town.....Time Received.....M...

Received By.....Phone / Verbal / Letter

Date.....Floor.....Phone.....

Keys At.....

Meter No.....Index.....Size.....

Date Meter Set..... ...Seals.....

Nature of Request.....

Referred To.....

Customer's Signature.....

Signed.....Date.....Time.....M.

Account No..... J.O. No.....Truck No.....
Make of Appliance.....
Make of Control, if defective.....
Condition of Appliance - Good.....Fair.....Poor.....
Miscellaneous Appliance.....

REPORT ON CAUSE OF SERVICE CALL

	Range	Refrigerator	Water Htr.	Space Htr.		Range	Refrigerator	Water Htr.	Space Htr.		Range	Refrigerator	Water Htr.	Space Htr.
Adjust					Fuse Plug					Readapt				
Burner					No Gas					Rel-Valve				
Burner Ov.					Gas Valve					Reconnect				
Burner Top					Grease					Restricted				
By-Pass					Ign-Gas					Repair				
Capacity					Ign-Elec.					Scale				
Clean					Input H					Thermostat				
Circ-Air					Input L					Too Hot				
Condensa					Inspect					Too Cold				
Control W					Impro. use					Turn On				
Defective					Leaks					Turn Off				
Defrost					Limit Swt.					Vent-Reg.				
Diaphragm					New Unit					Flue Pipe				
Dirt					Not Level									
Disconnect					Noisy									
Door Seal					Pilot									
Exp-Oper					Pilot Sfty									
Filters					Pressure									
Fur-Coil					Pre-Air									

REMARKS: .....

What will the gas range of th

of the future be like . . . and WHY?

DISCUSSION NO. 3

Burners will be "tailored" to the gas

Just as the modern aircraft engine is designed to use high octane gasoline and the Diesel engine low grade crude oil, so too will future gas range burners be designed to burn most efficiently the gas on which they will be used.

Originally it was thought that one type of gas burner could be used satisfactorily on all gases. These so-called "compromise" burners have been tried—the net result proving that no suitable compromise is possible.

A "compromise" burner can't give appliance users the full advantages that are actually possible with gas. Such a burner doesn't get the best economy of operation on bottled gas—it wouldn't have the fastest speed on natural gas—nor could it get full flexibility on manufactured gas. Tailor-made burners for each of these gases, on the other hand, give the *utmost in economy, speed,* and *flexibility.*

Surely appliances must be provided to utilize the best advantages of gas as a fuel. This is basic.

HARPER-WYMAN COMPANY

8562 VINCENNES AVENUE
CHICAGO 20, ILLINOIS

HARPER · BURNER SYSTEM ·

2-burners-in-1

these costs prior to the war was upward and we are hoping we shall be able to keep them from rising further or perhaps reduce them. It is pretty much axiomatic that as our appliances are made fully automatic in greater numbers and in greater variety and as they are made more efficient, the potential number of service calls to be incurred will increase. Costs of service calls will be higher because it takes a higher class and a better trained service man longer to adjust or repair this kind of an appliance than it did the non-automatic less efficient type of the past. Costs will be even higher with improperly trained men. This condition brings up a matter of growing importance as service costs rise, labor shortages increase, competition gets keener and appliances become more complicated. I refer to the need for more intensified and effective training methods.

The service man should no longer be merely a "screwdriver and appliance artist." The standards for service men must be raised. They should be familiar with the principle of operation and the adjustment to make on every type of appliance with which they come in daily contact if the appliances are to function as the manufacturer intended them to and if repeat calls for further adjustment of the same appliance are to be avoided. Each service man must be taught to think, to analyze each situation, make the proper adjustment or diagnose the cause of operational failure and, what is of great importance, he must be taught to fill in an intelligent report, the appliance he worked on, his findings, and the steps he took in remedying the trouble. He must be a diplomat for he represents the company and the customer expects him to know all about the gas business. From the correspondence and contacts I have had so far it appears that a number of companies are fully cognizant of this need for training and are doing something about it. The service man is one of the most important factors in our relations with the public. Upon his skill and tact rests a great deal of the responsibility for making or injuring our reputation with the customer. Every gas company must sooner or later recognize the value of properly trained service men, they must recognize that the service department personnel must be of a caliber susceptible to considerable technical training and that the service department must be maintained on a high level so far as the type of personnel is concerned.

Many companies long ago recognized the importance of carefully choosing and properly training service department personnel. Mr. H. D. Lehman of the Philadelphia Gas Works Co. as far back as 1934 stated "If high quality of work at reasonably low costs is to be accomplished with appliances now in use I think it is obvious that a high type of personnel is indispensable, that they preferably be men with high school or trade school education, having a capacity to learn and apply semi-engineering facts and can use fairly delicate instruments."

Mr. D. E. Farmer, Portland, comments: "There can be little question that in the highly competitive situation which will prevail in the post-war period, customer service departments will be called upon to assume an increasingly important role in securing acceptance of gas fuel and in promoting and maintaining good customer relations. With this fact in mind the personnel required must be carefully trained, selected and recognized."

Mr. H. W. Reed, President of the Philadelphia Gas Co., has said: "The most serious problem facing the gas industry today is not production or distribution or accounting, but sales —sales of trouble-free efficient gas appliances that are equal to or superior to competitive equipment."

In conclusion, it seems to me that the words I have quoted from these men are a challenge to our Customer Service Departments. A challenge which we can meet by the methods I have placed before you. More attention to personnel, systematic training of that personnel in a manner which will make it fully capable of coping with "semi-engineering facts" and "delicate instruments" (to quote Mr. Lehman), intelligent gathering of data and analyzing of appliance performance, passing of this information along to the manufacturers through appropriate channels, will, I feel, bring the answer to the problem which Mr. Reed says is the "most serious one facing our industry." These things if done will result in "The production and sale of trouble-free, efficient gas appliances that will equal, or be superior to, competitive equipment."

Kitchen Planning for the Gas Industry

A post-war section on Kitchen Planning for the gas industry appears as part of the March-April issue of Servel News issued by Servel Inc., Evansville, Ind.

As an aid for the convenient use of this service, the articles published in the Post-war Section have been so laid out that the section may be removed from the magazine and the various articles torn out and indexed according to specific subjects.

The articles are also available in reprint form. If you desire additional copies, you may have them on request. They are of the proper size either for standard three-ring binders or for regulation file folders.

Each issue of the "Servel News" will initiate another subject. This issue, for example, begins an authoritative study on Kitchen Planning, and continues the discussion of Dealer Cooperation started in the previous issue.

Articles on these and other subjects will continue to appear in the Post-war Section of the "Servel News" until the investigation of the subjects is completed or fully satisfied.

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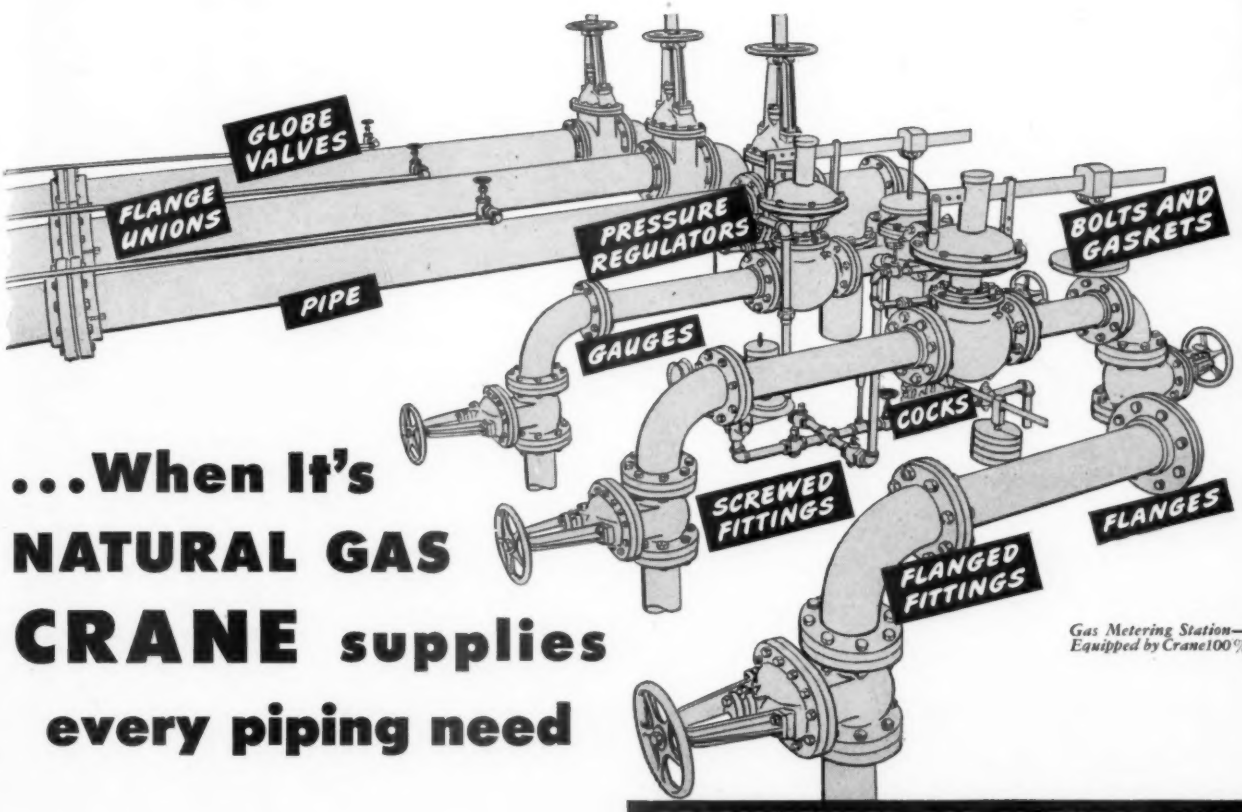

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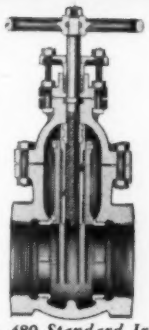

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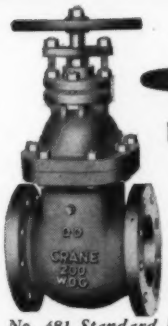

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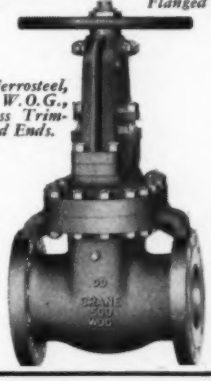

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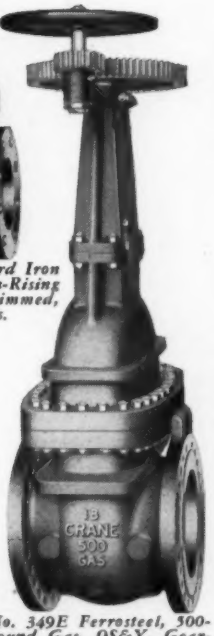

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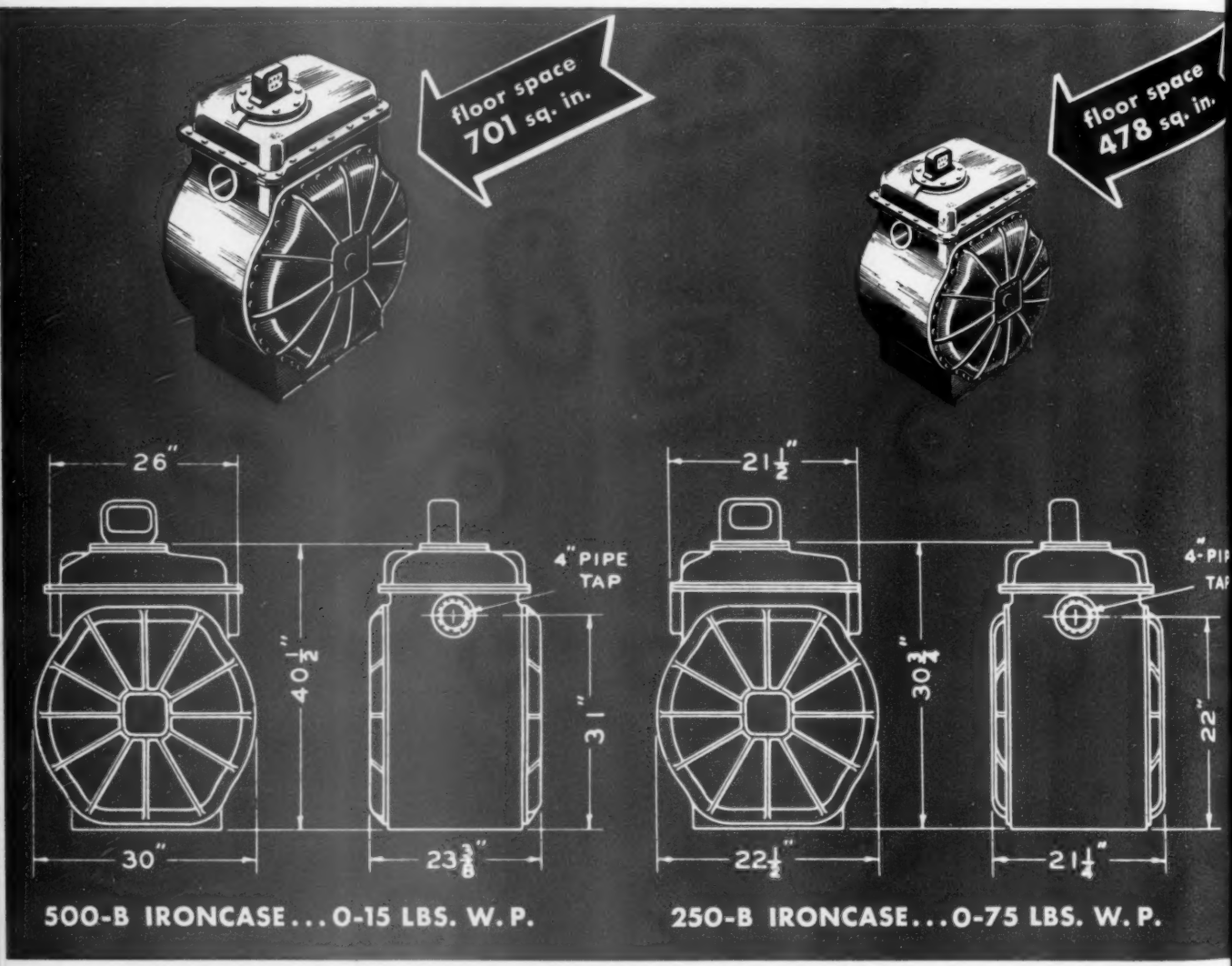

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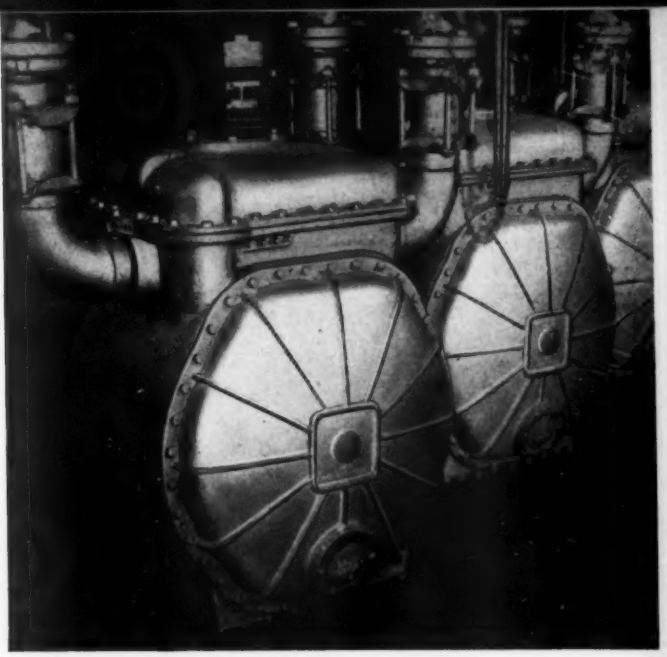

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Then he said to himself

"THIS WAR HOLDS UNPREDICTABLE DEVELOPMENTS"

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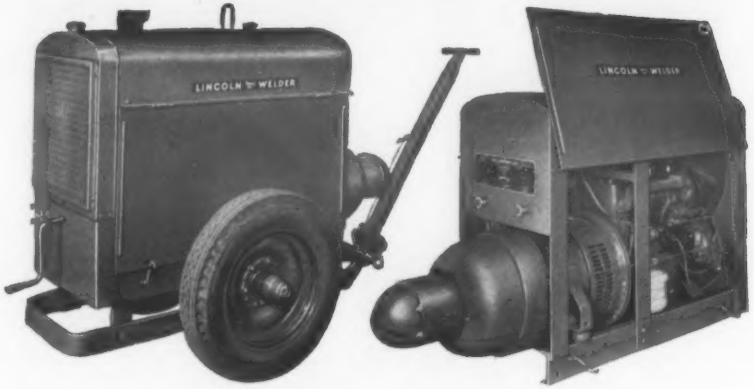
But there was enough on the "political plane" to slam his chin back in his collar, and if one wishes to read a moral into his statement, it could well be:

You always lead with your chin when you team up with the wrong working partner.

It is then you get unpredictable results of a DESTRUCTIVE nature.

"Unpredictable Developments" he says

Look, Benito (wherever you're in hiding), how men achieve predictable developments of a CONSTRUCTIVE nature when through recourse to Lincoln, they team up with a CONSTRUCTIVE partner. For example:



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ARC WELDING

Harbor Steam Plant at Los Angeles Equipped for Oil or Gas Fuel

By
Fred A. Herr

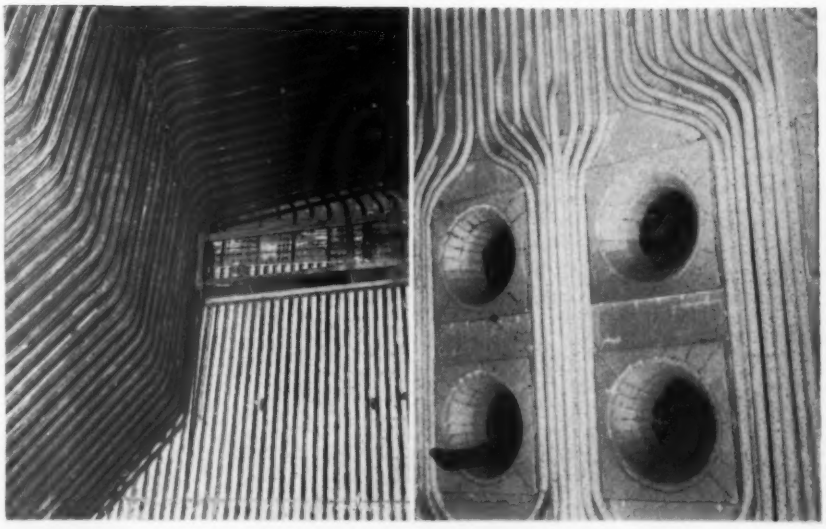
RANKING as the largest of its kind west of the Mississippi River, the huge boiler, with a capacity of 575,000 lbs. steam per hour, in the new steam generating plant which the Los Angeles Bureau of Power & Light has placed in operation in the Los Angeles Harbor District is designed to consume 900,000 cu. ft. of natural gas per hour.

The project, called the Harbor Steam Plant, cost approximately $9,000,000. It was built to provide the city of Los Angeles with auxiliary electric energy at high load at times when secondary energy supplied by Boulder Dam is insufficient to take care of the city's needs, for instant emergency use and to serve as a spinning reserve to the Boulder Dam transmission lines during other periods.

Before the design of the boiler room and boiler were undertaken, the Bureau made a series of economic studies based on an ultimate plant capacity of 300,000 kw power output. The studies determined that a steam generating unit with a capacity of 570,000 lbs. of steam per hour continuously and 675,000 lbs. for two hours, burning either natural gas or oil, would best suit the purpose.

Bent Tube Boiler

The type of boiler ultimately decided upon is a 3-drum Riley-Stoker Corp. model with bent tubes and fitted with bare water walls. It has a fourth or dry drum to prevent carryover of solids. Cubical content of the boiler is 3500 cu. ft. below the centerline of the main drum. Steam temperature at the superheater outlet is 915° F. at 250,000 lbs. of steam per hour or more. The furnace volume is 22,500 cu. ft. Other details of the boiler are: Heating surface, 24,100 sq. ft.; water walls, 6800 sq. ft.; superheater, 23,300; economizer, 12,000; air-preheaters, 66,400; other parts, 770 sq. ft. The high-temperature steam pipes are of carbon molybdenum alloy. Pipe insulation consists of high-temperature insulation where necessary and 85% magnesia laced to the pipes with chrome vanadium wire.



On the left: Arrangement of boiler tubes and water wall. On the right: Four of the ten Peabody burners installed in the boiler, which are designed for burning either oil or gas. For the duration of the industrial gas shortage in Southern California the plant will use oil as fuel, but the decision of the Bureau of Power & Light is to convert over to natural gas as soon as sufficient quantities of gas are available.
Photos courtesy of LA. Dept. of Water and Power

Peabody Gas Burners

Burner installations in the boiler consist of ten Peabody Type H-26 combination oil-gas burners. They are designed to burn natural gas at the rate of 900,000 cu. ft. per hour, or oil at the rate of 6000 lbs. per hour. The original plan of the Bureau of Power & Light had been to use natural gas as boiler fuel from the beginning, but a temporary change in this plan had to be made when a shortage of industrial gas developed in Southern California due to the tremendous demands made by war plants. This situation accounted for the decision to use fuel oil in the boilers until the industrial gas supply situation eases to the extent of making that fuel available in sufficient quantities. For the reasons cited above the Peabody burners in the Harbor Steam Plant's boiler initially were set to burn oil, which fuel will probably be used for an indefinite period.

The gas burning features of the Peabody burners, however, are already in place and when industrial gas in sufficient volume becomes available, the change-over to gas fuel will be made, according to William C. Rouse, steam design engineer of the Bureau of Power & Light, who stated that the choice of gas as the ultimate permanent fuel for the plant was dictated by the fact that the plant could be operated more economically with natural gas as boiler fuel.

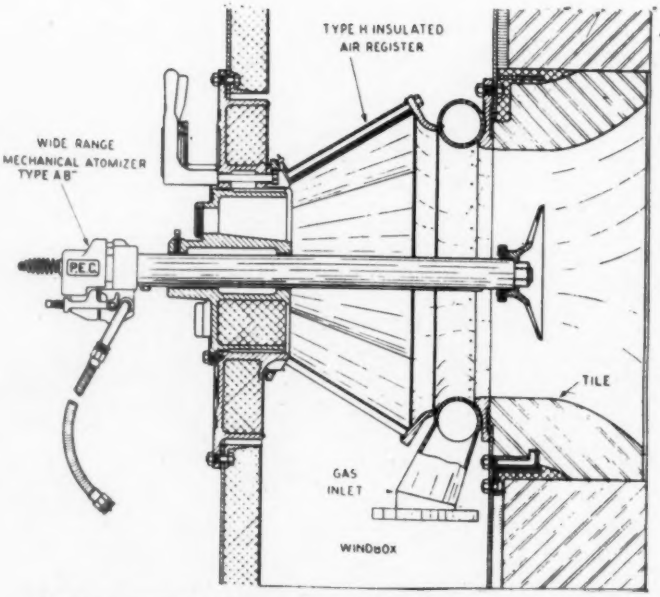
Will Hook Up for Gas

When the change over is made, the Southern California Gas Co. will need only to install metering devices in the main supply lines, with the Bureau of Power & Light personnel carrying on the conversion work from the meters to the boiler, where minor changes will become necessary to hook up the burners for gas consumption.

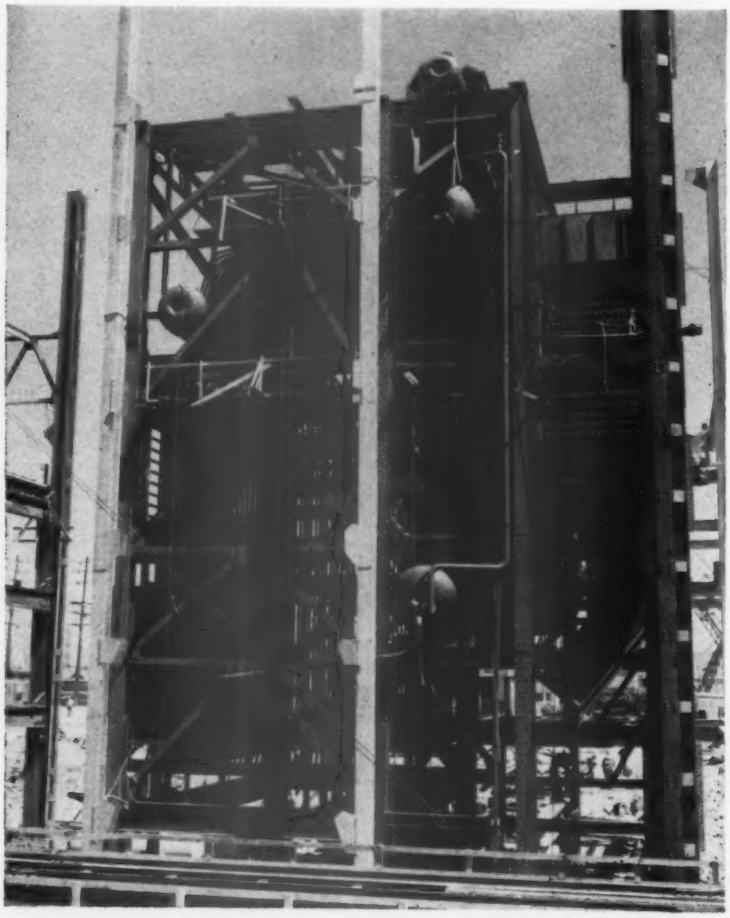
Irrespective of the exceptional size and design of the boiler, the Harbor Steam Plant is of further interest because it is equipped with the largest 3600 rpm condensing unit in the United States. The building also represents some unique departures from standard practices of construction and installation of machinery, which became necessary because of the tremendous size and weight of steam condensing equipment. The great weight of the boiler and turbo generator, for instance, made it necessary to erect boiler and generator rooms on floating reinforced mat foundations, separate from the foundations of the main building.

Boiler Room 8 Stories High

The boiler room rises 83 feet to the height of an eight story building. It houses the boiler, furnace, furnace water walls, superheater, economizer, preheater and pipes of the superheating system which steps up the power to a maximum of 675,000 lbs. steam per hour at 1050 psi. in the main steam drum at a temperature of 915° F. at the superheater throttle.



Complete combined gas and oil Peabody burner shows gas burner ring and gas inlet. Gas burner saddle holds the gas ring in position.



This shows the boiler installation in the Los Angeles Bureau of Power & Light's new $9,000,000 Harbor Steam Plant, which is designed to burn natural gas at the rate of 900,000 cu. ft. per hour. The boiler room is erected on foundations separate from those of the main building and has the height of an eight story building. This photograph was taken during the construction and before the metal walls were attached to the steel girders to make the boiler room a self-contained chamber.

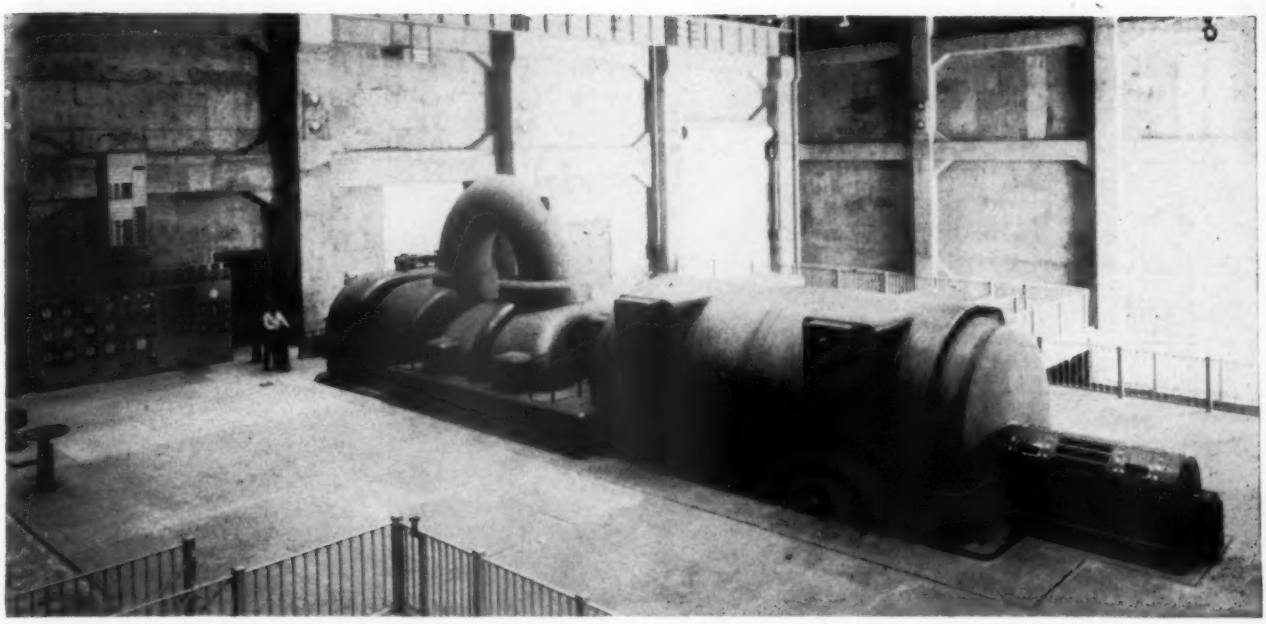
The boiler has a capacity of 675,000 lbs. of steam per hour at a pressure of 1050 p.s.i., and temperature of 915 Deg. F., the highest temperature and pressure installation in Southern California.

The steam generating unit includes the boiler, water walls, superheater, submerged type desuperheater, economizer, air preheater of the regenerative type, and combination oil-gas burner installations. All the foregoing equipment is enclosed in a metal shell bolted to structural steel columns 83 feet high, the steel columns furnishing support to the steam generating unit independent of the rest of the building.

The plant is equipped with an Elliott twin horizontal, two-pass surface condenser. The setup consists of two half-size condensing units of 30,000 sq. ft. condensing surface each, joined by a connecting piece, and each of the units using 24,000 gpm cooling water. The condenser equipment has a rated performance of 1 in. abs. at 403,900 lbs. steam per hour at 65,000 kw. It contains muntz-steel tube sheets, cast-iron water boxes, a deaerating hot well and steam air ejectors for 800 psi gauge, 900° F. steam.

Novel Condenser Setup

Because of the large size of the condenser and the comparatively small dimension of the turbine, a novel method of installation was resorted to. The usual method of mounting the condenser crosswise directly below the turbine exhaust was



The turbine room on the first floor of the steam plant, shows the main turbine, a tandem-compound installation which is rated as the largest 3600 rpm condensing turbine in the United States; it drives a hydrogen cooled 65,000-kw generator.

The main steam condenser, a 2-pass surface condenser with connecting piece, having 60,000 sq. ft. of condensing surface, is mounted in twin sections below the floor level shown here.

The boiler room is to the left of the turbine room, beyond an auxiliary bay which separates boiler and turbine rooms.

found to be impracticable because such a setup would have been possible only if the condenser were built in the form of a tall, narrow unit and placed under the *turbine*. This method would have raised the 932,000 lb. turbine generator to an undesirable and inconvenient height above the working floor.

As ultimately installed, two condensers are used. Each condenser is half the size of the single unit originally considered and one is set up on either side of the turbine, with a connector leading from each unit to the turbine exhaust. This arrangement is installed below the turbine and provides a low center of gravity for the latter.

A 127-foot smokestack rises from the rear of the boiler room. By placing the base of the stack close to the ground, instead of on the roof, it was found possible to lower the height of the building 23 feet, and incidentally save a considerable amount of steel. Two radial tip induced draft fans of 205,000 cfm each are installed on either side of the stack outside the boiler room, and two forced draft fans of 125,000 cfm each inside the boiler room.

Seawater taken from Los Angeles Harbor through an intake structure at the shore line is used for circulation through the condenser.

The Bureau of Power & Light engineering staff drew plans and specifications for the plant, with erection proceeding under the general supervision of H. V. Gardett, chief engineer of the Bureau, and R. R. Robertson, engineer of design and construction. W. C. Rowse supervised design and administration of the steam plant equipment. Contractor for the main buildings was the Zimmer Construction Co. The steam generating unit and auxiliaries, including the Peabody burners, were installed by the Riley Stoker Corp.; main steam condenser by the Elliott Co.; deaerating heater by the Permutit Co.; condensing circulating water piping by M. K. Kemper; other piping by Blaw-Knox Co.; fans by American Blower Co. and Lacy Manufacturing Co.

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Value of Industrial and Commercial Gas Load to Utilities

By
Edward N. Strait
Manager Rate and Research Division
Public Utility Engineering and
Service Corporation
Chairman A.G.A. Rate Committee

WHEN I was invited to present a paper at this conference of the Industrial and Commercial Gas Section of the American Gas Association, on the Value of Industrial and Commercial Gas Load to Utilities, my first reaction was that this would be another case of "Carrying Coals to Newcastle"; for who naturally would know more about the subject than the members of this Section. Of course, that was an initial and superficial reaction. The true reaction naturally followed, namely: Who should more desire to understand the facts about this matter than those whose time, energy and thought are actively enlisted in this phase of the gas industry?

Perhaps I should say at the outset that whatever views or opinions may be expressed in what follows are only my own and that I am not now speaking for any committee or other group. It is no real confession, but a matter which can be appreciated by all, that, in order to discuss the subject with you, it has been necessary for me to reexamine a bit certain aspects of the industry, much as you would do, no doubt, if you were placed in my position. Even before leaving the Association's headquarters, on the occasion when the understanding was reached about discussing the subject, it occurred to me that, in order to consider the importance of the industrial and commercial load it is essential to understand something of the trend of industrial and commercial gas sales over the years, with respect both to the volume of such sales and to their relative amount compared with the total for all classes of the gas business. I was immediately supplied by the Association's staff with printed statistics on the subject, all of which any of you also can obtain from the same source and can examine in detail at any time. But, just now, let us, for brevity, consider only the broad generalities.

Presented at American Gas Association 1944 War Conference on Industrial and Commercial Gas March 30-31, Rochester, New York. Read by H. A. Sutton in the absence of the author.

Right here we encounter the fact that the gas industry is divided into two major branches, namely, manufactured gas and natural gas. You, who are engaged in the gas business, know the essential differences in conditions which arise primarily from variations in production and transmission and also in the heating value. These differences affect the costs, the distribution problems and the feasible markets. Therefore, the statistics of the industry have been kept separate for these two branches of it. Certain of these statistics covering volume of sales by classes of service, for the period of 1929 to 1943, inclusive, have been presented in striking graphic form in the report by President Ernest R. Acker in the A.G.A. Monthly of January, 1944.

While it would be interesting to pursue our entire inquiry in relation to the main subject separately for manufactured and natural gas, too much time would be required for it. Just for the present, let us look at the trends separately and then pass to a more general consideration of the subject.

Trend of Volume of Sales of Manufactured and Natural Gas

In the case of the manufactured gas industry, a decline in total sales set in about 1930 and reached its lowest ebb in 1933. From that time on, a gradual increase in total sales occurred, reaching an annual aggregate of 481,772 million cubic feet in 1943, approximately 56 per cent above the low level of ten years before. The decline in industrial and commercial sales began a little earlier and reached its lowest level in 1932, remaining about the same in 1933, after which a marked growth occurred, reaching a total of 174,054 million cubic feet in 1943, which was about 162 per cent above the industrial and commercial sales of 1933. In 1933, the industrial and commercial sales of the manufactured gas industry amounted to 22 per cent of the total, while in 1943 the industrial and commercial sales increased to 36 per cent of the total.

In the case of the natural gas industry the relative situation was much the same. A decline in total sales, beginning in 1930, reached its lowest level in 1932. A steady increase thereafter brought the total natural gas sales to 1,983,487 million cubic feet in 1943, approximately 137 per cent above the low level of 1932. During the same period, the industrial and commercial gas sales, excluding natural gas used for electric generation, decreased to its lowest level in 1932, after which it climbed to 1,183,316 million cubic feet in 1943, representing an increase of 190 per cent above the industrial and commercial sales of 1932. In 1933, the industrial and commercial sales of the natural gas industry were 53 per cent of the total, while in 1943 they were 60 per cent.

Statistics at best are rather dry and uninteresting and further time will not be taken in this short paper to go into other important statistical aspects of the gas industry. Enough is shown by these brief statements to reveal the real and growing importance to the gas industry, both manufactured and natural, of the industrial and commercial sales from the point of view of volume. The fact that the growth of industrial and commercial sales has been more rapid than the growth of total sales is indication enough that the growth of domestic sales has been much slower. In fact the domestic sales of manufactured gas in 1943 were slightly less than 10 years before; while those of natural gas increased 68 per cent in the same period.

Cause of Recent Growth of Industrial and Commercial Gas

It is natural and correct, of course, to attribute much of the recent growth of the industrial and commercial business to the war effort.

The manufacture of raw materials and fabrication of implements of war have required, during the war years, enormous amounts of gas for industrial heat applications. That new impetus was given to the development of processes of industrial utilization of gas by the war requirements cannot be questioned. Nevertheless, when the trend of industrial and commercial gas consumption is surveyed over the period of the past ten years or more, it is observed that the volume in the war period is not much greater than that which would have occurred if the upward trend of gas utilization, prior to the general business recession in 1937 and 1938, had continued unabated. In other words it appears that, had normal conditions continued in effect during the past 10 years, the unimpeded growth of civilian requirements of gas for industrial and commercial purposes might well have necessitated the volume which now, in comparison with present civilian utilization, seems so large. From this we may draw the conclusion that, except possibly during a period of reconversion, postwar requirements of industrial and commercial gas for civilian purposes may, with adequate sales-attention, equal or approximate the gas loads now supplied for war purposes.

It is important to observe, on the other hand, that, unless the gas industry can, in fact, replace the war requirements for gas with commensurate requirements for civilian purposes, it is apparent that a serious recession in the gas load will occur.

Value of Industrial and Commercial Gas Business to the Utilities

Thus far we have considered the sale of gas for industrial and commercial purposes only in relation to its volume. While the volume of sales in any business may be quite impressive, volume alone is only one aspect of its possible importance to the industry. The question of real importance is whether growing volume of sales leads to or maintains a sound financial position of the seller, or results in undermining a satisfactory position already attained, or merely continues to maintain an existing inadequate financial position. It is necessary for any business to guard against a situation of diminishing returns, which is certain to develop when its sales are expanded under a structure of inadequate prices. It is apparent, therefore, that the value of any class of business is a function of both its volume and its price.

Much of the gas business classed as industrial and commercial is sold under what are regarded as competitive conditions. The competitive conditions are determined either by the relation of the price of gas used by the customer to the value of his product or by the relative cost of an alternative source of heat which the customer regards as adequate for his purpose. In either case the value of the gas service to the customer is involved. Such conditions fix the maximum prices which can be obtained in certain instances for industrial and commercial gas, and such maximum prices are likely to vary with different types of utilization. This, then, places the gas utility either under a limitation of the sales to those uses of gas which can be reached by a single scale of rates or under the necessity of establishing levels of rates for different categories of utilization, depending upon their different competitive conditions. Much of the present industrial gas load has been developed under rate structures that give effect to value of service.

It is of interest to note that the Public Service Commission of Wisconsin, in a recent investigation on its own motion, involving Milwaukee Gas Light Company, and certain other Wisconsin utilities, asserted a strong but qualified opinion in support of rates designed to meet the value of service. The opinion was strong in approving value of service as an important factor in rate-making; it was qualified in asserting that the rates so established must be adequate to benefit the business and its customers as a whole. In that important case, the Wisconsin Commission made the following statements, which are given here in their natural order but with certain intervening omissions for the sake of brevity:

> **"It is apparent that by the filing and approval of the space-heating rates here involved, there was created a new class of service which respondents then undertook and have ever since furnished to a new class of customers. . . .**
>
> **"Both the staff (of the Commission) and respondents agree, and we agree with them, that there was a logical basis, and hence a justification, for placing respondents' space-heating service in a separate class for rate-making purposes. . . .**
>
> **"The essential fact which makes the respondents' space-heating service different from any other service which they furnish, and thus justifies the separate classification for that service, is the simple fact that gas used for space-heating is not worth as much to the consumer as gas which is used for the other purposes for which respondents other consumers make use of gas. . . .**
>
> **"The difference in value between gas for space-heating and the same gas for other uses furnishes the logical basis for the separate classification for respondents' space-heating services because of the fundamental principle of rate-making that reasonable utility rates cannot result in charges for any utility service which are more than such service is worth to the customer. . . .**
>
> **"In fixting the price of gas for space-heating service, by the approval of the rate schedules here involved, the proper aim of the Commission was to prescribe a rate which should be, as nearly as possible, the full value of gas for space-heating purposes. . . .**
>
> **"The incremental costs incurred by respondents in producing the gas used in furnishing their space-heating services (i.e. the additional direct, or out-of-pocket costs incurred in producing the additional amount of gas required for such services) may serve as a criterion for determining the minimum level of rates at which such services could be furnished without direct injustice to consumers of other services and palpable discrimination. But our proper aim is not any minimum of rates that could be prescribed for space-heating services without discrimination, but rather the maximum of rates, within the limitations of the value of such services and of the rates charged for other services involving comparable consumption of gas. . . .**
>
> **"It is our conclusion, therefore, that the essential fact which justifies lower rates for respondents' space-heating service than are prescribed for their other services involving comparable consumption is the fact the gas for space-heating is not worth as much as it is for the purposes for which such other services are used; that, so long as such difference in value continues and a resulting differential in rates prevails, the rates for respondents' space-heating service should, as nearly as possible, result in charges of all that such service is worth; . . ."**
>
> **Re Milwaukee Gas Light Company et al:**
> **51 PUR (NS) 299**

The foregoing views of the Wisconsin Commission are in harmony with the Wisconsin law which provides that "The Commission shall provide a comprehensive classification of service for each public utility, and such classification may take into account the quantity used, the time when used, the purpose for which used, and any other reasonable consideration." Laws of various other states are in general accord with this provision.

Although the foregoing opinion of the Wisconsin Commission was given in a matter involving rates for manufactured gas, there appears to be no reason why the same principle of rate-making does not apply equally

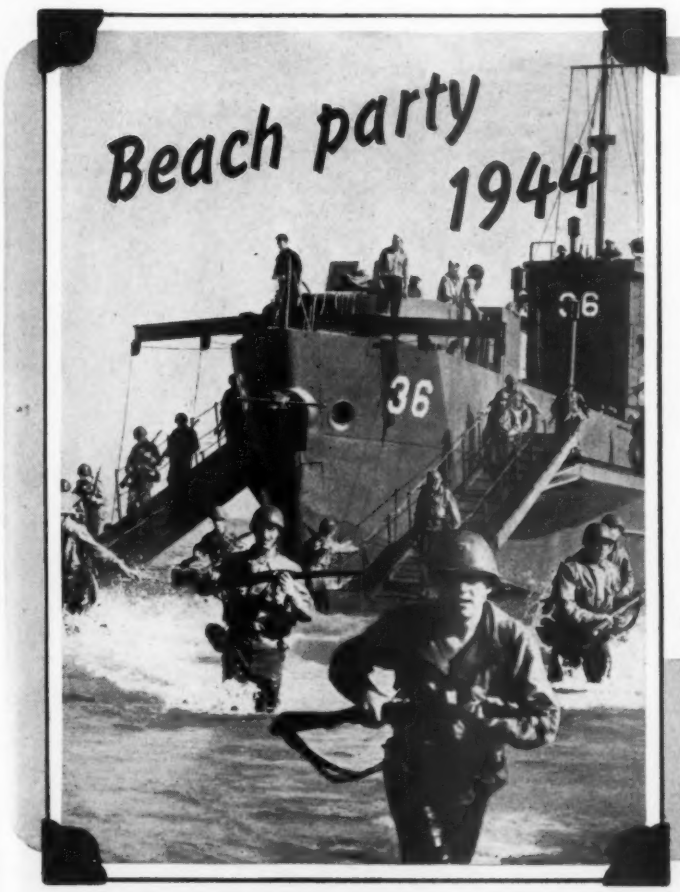
in the case of natural gas. In fact, it has been followed even more extensively in the natural gas industry. However, in this connection attention is directed to the dissenting opinion of Mr. Justice Jackson of the United States Supreme Court in the recent case involving the rates of Hope Natural Gas Company,* in which he asserted that, because of the irreplaceable character of natural gas its sale for industrial purposes should be restricted and the gas should be conserved for other purposes, such as domestic uses, wherein the value to the consumer lies in other directions than its low cost. This theory, which was not adopted by the Court, is expressive of a social philosophy upon which our present laws with respect to natural gas evidently do not rest. It would give preference to certain possible classes of use by future generations against other classes of present-day utilization, without giving consideration to the possibility of changes in the art of heating, over the future years, which may produce adequate substitutes through manufacturing processes. At any rate, so long as natural gas is not wasted but is utilized in economical and effective ways, who can say that its use today will not benefit mankind at least as much as its reservation for future uncertain purposes? Certainly one of the important benefits of industrial utilization of natural gas is its share in the support of production and transmission facilities so necessary to the supplying of domestic requirements.

We now come to the important question of how can a gas utility determine the value to it of any class of its business. It can do so only by weighing the present established price, or the obtainable price, for that class of business against the cost of supplying it; and this may involve the matter of incremental costs, referred to by the Wisconsin Commission, if value of service is involved in the rates. Of course, it is not possible to determine with exactness the costs for any particular class of service among several which utilize, in common, many of the facilities and operations of the business. However, thoughtful economic study of a company's business, based on information which can be produced by those individuals of the company's organization who are acquainted with such matters as the influence of load and volume on the required amounts of facilities, supplies, labor, and so forth, can result in the development of guiding-relationships of costs and prices. Such relationships will indicate whether expansion of sales at a given price level will produce satisfactory or detrimental financial results. The developed relationships will indicate also what, if any, adjustments of the price level may be necessary or desirable from an earnings point of view, although, to be sure, the adoption of adjustments may be controlled or prevented by other factors. In those instances in which decreasing returns will result from expanding business, such expansion should, of course, be terminated if the price level cannot be increased.

Principal Problems To Be Solved

There are, then, two principal problems to be solved by a gas utility interested in the question of the value to it of an industrial and commercial load. One is the problem of sales development, involving surveys of the potential market and the rate levels necessary to obtain the avail-

(Continued on page 74)



U. S. ARMY SIGNAL CORPS PHOTO.

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Twenty-first Annual Distribution Conference of A. G. A.

OVER 300 gas distribution engineers registered at the twenty-first Annual Distribution Conference of the American Gas Association, held April 18th and 19th at Statler Hotel, Cleveland, O.

A. C. Cherry, chairman of the Distribution Committee, presided and introduced J. French Robinson, president East Ohio Gas Co., who welcomed the delegates to the meeting and Cleveland.

Major Alexander Forward, Managing Director of A.G.A., addressed the meeting briefly. He stated that a recent survey of the gas industry conducted by the Postwar Planning Committee shows that more gas companies will merchandise appliances and more will work cooperatively with the dealers to promote sales after the war than before the war while still others heretofore not selling appliances have not yet reached a decision. This is a most significant fact.

E. R. Acker, President of the A.G.A. referred to the first meeting of distribution engineers 21 years ago at Toronto, Canada, and gave credit to J. Von Maur, engineer of distribution, Consumers Gas Co., Toronto, as being the father of the Distribution Conference. He then reviewed the major activities of the Association and stressed particularly the research work being carried on at the A.G.A. Laboratories.

The first paper was presented by Linn Edsall, Philadelphia Electric Co., Phila., Pa., on the subject "Safety Through Proper Driving Procedure."

"Accident analyses, bonus systems, company traffic courts, safety committees, all have their place," he said. "Their use should be continued and intensified, but their weaknesses should be recognized and supplemental measures taken to assure results and to avoid, in so far as possible, the imposition of penalties, a disciplinary measure particularly difficult of administration.

"In the end, the most important thought I would leave with you is that we have been wrong for years, in assuming a driver's license makes a man a good driver and if he holds a license, he can be trusted to operate with safety, a vehicle powered by an engine of 150 horsepower. It has not worked that way in the past; it will work that way even less in the future. Let us give our motor vehicle drivers a fair chance to be the kind of drivers they would like to be and the kind we would like them to be."

Standing:—L to R: L. A. Evarts, Mineola, L. I., N. Y.; S. E. Trouard, New Orleans, La.; L. K. Richey, Detroit, Michigan.
Sitting:—L to R: R. J. Kuhn, New Orleans, La.; K. H. Logan, Washington, D. C.; R. F. Hadley, Philadelphia, Pa.; Guy Corfield, Los Angeles, Calif.

Photo. A. Gordon King

L. to R:—T. H. Kendall, Vice-Chairman, Pittsburgh, Pa.; J. French Robinson, Vice-President A.G.A., Cleveland, O.; A. C. Cherry, Chairman, Cincinnati, O.; C. F. Turner, Cleveland, O.; L. E. Knowlton, Providence, R. I.

Photo. A. Gordon King

"Mixed Gas Research" was the subject of paper read by H. O. Lobell, chairman Mixed Gas Research Committee. "The work," he said, "has been in progress for approximately one year and considerable data from which suitable interchangeability limits can be determined have been obtained. To date, investigational work has covered the following mixtures:

"1. High Btu. carburetted water gas varying from 800 to 1400 Btu. per cu. ft.

"2. Butane (propane) — air plus natural gas in varying percentages.

"3. Butane (propane)—reformed butane (propane).

"4. Butane (propane)—reformed natural gas (using steam or air).

"5. Butane (propane)—blue gas.

"6. Butane (propane) — producer gas.

A summary of the results obtained from each mixture was given.

The second day meeting opened with a paper by K. H. Logan, National Bureau of Standards, Wash-

Above: L to R:—Donald Whitcomb, Atlantic Highlands, N. J.; Frank Engel, Elizabeth, N. J.; D. M. Steen, Far Rockaway, N. Y.; L. E. Knowlton, Providence, R. I.; J. A. Noble, Lockport, N. Y.; J. A. Mulcare, New York, N. Y.; A. Messenger, New York, N. Y.; G. Mock, Washington, D. C.

Photo. A. Gordon King

ington, D. C., titled "Coatings Useful for Distribution Systems," which is printed in this issue of the *Journal.*

J. V. Postles, chairman, Committee on Post-war Planning Cooperation, was unable to attend the meeting but telegraphed a brief report.

J. M. Pickford's paper on "The Service Department's Stake in the Development of Post-war Gas Appliances" will be found in this issue of the *Journal.*

D. N. Steen, Queens Borough Gas & Electric Co., Far Rockaway, N. Y., in his paper discussed post-war gas appliances from the servicing viewpoint, and C. C. Jones, Philadelphia Gas Works, presented a report covering the history of the development of cast iron pipe standards, and a general description of the information it is planned to include in the new standards publication.

Two luncheon conferences were held on both days of the meeting, No. 1, Pipe Coatings and Corrosion, R. F. Hadley, chairman; No. 2, Work on Customer Premises, J. M. Pickford, chairman; No. 3, Meters and Metering, J. H. Collins, chairman; No. 4, Construction and Maintenance, H. W. Nicolson, chairman.

On Monday and Thursday a large number of delegates visited the A.G.A. Laboratory and the East Ohio Gas Company plant.

Group from Public Service Electric & Gas Co. of N. J. Front:—L to R: James H. Galt, H. W. Nicolson, L. M. Harris, Harry Ellis. Back:—L to R: James C. Costello, J. Ashworth, H. G. Stange, W. F. Terradell, I. S. Webster.

Photo. A. Gordon King

Supreme Court Overrules O. P. A.

The United States Supreme Court on March 27 sustained a rate increase granted to the Washington Gas Light Company which the Administration had opposed as inflationary and against the policy of the war stabilization program.

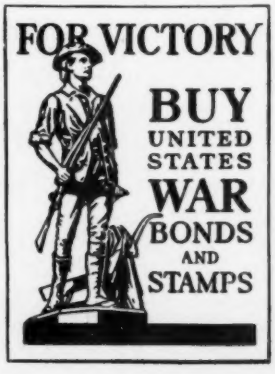
The Office of Price Administration, supported by Fred M. Vinson, Director of Economic Stabilization, had insisted that its general powers gave it the right to fight the increase permitted by the District of Columbia Public Utilities Commission. The Supreme Court, however, through Justice Owen J. Roberts, held it impossible that the OPA could supersede the District Commission in authority, and added that during the rate hearings the Government had failed to take the opportunity to present proper testimony.

Justices William O. Douglas, Hugo L. Black and Frank Murphy dissented from the majority.

Throughout the Roberts opinion was the implication that utility commissions would retain their regulatory authority despite contentions of the OPA. For the court to uphold the contention of the OPA would mean, Mr. Roberts said, a reversal of a former Supreme Court opinion and "to infer from a general expression of Congressional policy, the limitation of existing powers conferred by law on regulatory commissions throughout the nation, both State and Federal, and the endowment of a different Federal agency with new and superior rights and powers."

The gas rate increase of $201,424 retroactive to Sept. 1, 1942, amounted, Mr. Roberts said, only to about 3 cents monthly to a customer.

The controversy was essentially one between two governmental agencies as to whether the powers of the one or the other are preponderant.



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Recovering Residual Gas With a Rotary Compressor

By

George W. McKinley,

Engineer Hope Natural Gas Company
Clarksburg, West Virginia

IN THE PAST it has been common practice to abandon any gas well or group of wells that no longer retained sufficient rock pressure to feed into the existing suction system. It was felt that the wells did not produce volumes sufficient to pay the cost of operation and maintenance. In many cases, this meant a definite loss in reserves when better methods of production would have greatly increased the recoverable gas.

The Hope Natural Gas Company was presented with such a problem when approximately 25 of its wells in Mannington District were found to have an average rock pressure of 24 psi., and located a distance of 6 to 10 miles from the main field station. This rock pressure allowed them to feed only a small per cent of their potential output and then at only infrequent intervals. It was decided that the production from these wells could be increased 6 to 8 times if the well head pressure was reduced continuously to approximately one-third the rock pressure.

It was recognized that any pumping unit to economically accomplish this purpose must have a low cost of installation, require little or no operating supervision and have low maintenance charges although in continuous operation. These conditions indicated the use of a rotating type of unit as exemplified by the centrifugal pump and the steam turbine, both of which owe their rapid development to these characteristics.

A rotary compressor of the sliding vane type seemed to satisfy most of these requirements. It has many desirable features, such as larger capacities in proportion to size, simple driving mechanism, few moving parts and no reciprocating parts, which eliminates vibration and gives a flow of gas free from pulsation. The compressor itself is quite simple, consisting of a cylinder with removable heads, all of which are water jacketed. A steel rotor with radial slots milled in it to receive the vanes, is mounted eccentrically in the cylinder. When in operation centrifugal force causes the blades to be forced out against the walls of the cylinder, forming small compartments. The rotor is so placed that it almost touches the bottom of the cylinder, making the compartments formed by the vanes very small at this point. The volume increases gradually as the rotor rotates, until at the top of the cylinder it has reached a maximum and again decreases to a minimum at the bottom. The suction is so arranged that full advantage is taken of the large volume of the compartments at the top and the discharge is at a point near the bottom where the volume of the compartments have been reduced to a minimum. A rotary compressor of this type actually compresses the gas.

Each compressor is equipped with a force-feed lubricator insuring a supply of oil to all parts of the compressor. The film of oil on the cylinder walls provides a running surface for the vanes, and forms an effective seal against slippage. The small clearances, together with the oil film, make it possible to obtain a high volumetric efficiency.

In order to eliminate the use of any auxiliary machinery, each compressor unit is equipped with a water circulating pump and a radiator, to which a suitable anti-freeze is added in winter. The compressors are directly connected to a motor drive and together with the radiator are mounted on a structural steel base. When mounted in this manner the complete unit is of a semi-portable nature. Mercoid pressure and temperature switches are used to protect the units against overloading and overheating due to suction and discharge pressure conditions. The mercoid switch on the suction will shut down the unit if the pressure drops below a predetermined point, likewise the switch on the discharge will hold that pressure below a certain desirable pressure. However, when the pressures have adjusted themselves within the range for which the switch is set the unit will automatically come back into service. The temperature switch is to prevent excessive temperatures developing in the compressor should the cooling water system fail for any reason. Safety valves are required to protect against excessive pressure conditions.

An efficient dust separator in the suction lines is an absolute necessity, because any dirt entering with the gas will be thrown against the cylinder wall. Here it will break the oil film and cause excessive wear of both the blades and cylinder. No suction and discharge valves are required, but a check valve is built into the compressor to prevent a reversal of the gas flow when the machine is not in operation.

This particular installation consists of four Fuller Rotary Compressors with composition vanes, each driven by a 25 H.P. 220/440 volt alternating current motor. They operate at a speed of 1160 R.P.M. and each has a capacity of approximately 150 cubic feet of free gas per minute against a 50 lb. discharge pressure. Each unit has a 25 H.P. starting switch and is protected against voltage surges by adequate fuses. The foundation requirements are practically nil, and 2 - 12″ x 12″ oak timbers 20 feet long have proven to be sufficient, since the units are practically free of vibration when in operation.

All four units are housed in a 12′ x 20′ x 7′ wood frame building with galvanized iron siding. The motor starting switches are housed in a small adjoining building of the same general construction.

No unnecessary expense was made during the erection of these pumping units because the economic success of such an installation depends on low first cost. The following table #1, giving details of the construction costs, shows that about 84 per cent of the total first cost has been in the compressing units and their protective devices, and the necessary electrical equipment. All, or any part of this investment, can be moved at will without entailing any great loss in building, foundations or labor. If the whole installation were moved, the loss would be less than 10% of the first cost or about $700.00. This feature is of particular importance because the life of an installation of this nature cannot be expected to be

TABLE NO. 1

Actual installation cost for 4—25 H.P. Rotary Compressors

4—Fuller Single Stage Rotary Compressors Complete with Motor and Starter	$5,696.32
4—Mercoid Pressure Control Switches	93.60
4—Mercoid Pressure Control Switches	90.00
4—Mercoid Temperature Control Switches	128.90
Dirt Screen	22.32
Electrical Equipment (Wire, Conduit, Boxes, etc.)	144.30
Pipe & Pipe Fittings	130.71
Oak Timbers for Foundations	31.31
Buildings (Material Only)	142.58
Labor	487.66
Teaming	74.50
Overhead and Expense	162.21
Taxes	12.82
Total First Cost of Installation	$7,217.23

TABLE NO. 2

Operating Cost of 4—25 H.P. Rotary Compressors based on Actual Records for One Year

Month	Units Running	Gas Pumped 14.65# & 60°F.	Kw.-Hrs.	Kw.-Hr. Per M.c.f.	Electric Cost	Electric Cost/M.c.f.
January	4	21,540 M.c.f.	37,400	1.74	559.85	.0260
February	4	22,661	38,000	1.68	560.50	.0247
March	4	21,469	30,960	1.44	462.10	.0215
April	4	24,275	36,280	1.49	532.07	.0219
May	4	23,245	32,640	1.40	438.24	.0189
June	4	21,755	34,840	1.60	492.46	.0226
July	4	20,225	30,960	1.53	480.46	.0238
August	4	21,346	34,640	1.62	488.16	.0229
September	4	20,861	33,560	1.61	472.21	.0226
October	4 & 3	20,482	36,000	1.76	487.46	.0238
November	3	21,964	27,240	1.24	425.28	.0194
December	3	18,800	23,000	1.22	307.88	.0164
		258,623 M.c.f.			5,706.67	.0220

Yearly Operating Costs	Total	Cost per M.c.f.
Electric	5,706.67	.02206
Operating Labor @ $0.94/Hr.	171.95	.00066
Lubricating Oil	197.00	.00076
Maintenance (Equipment & Labor)	5.62	—
Out of Pocket Cost	6,081.24	.02348
Fixed Charges on $7,217.23 (5% Interest & 10 Year Life)	934.63	.00361
Total costs	7,015.87	.02709

longer than 4 or 5 years in any one location. By the end of that period or an even shorter period, there will not be sufficient rock pressure remaining to cause a flow of gas without maintaining a high volume.

Operating records for the year 1943 show that a maximum of one-half hour per day of operating labor is sufficient to more than meet the requirements. In fact, it is only necessary to visit the installation once every three days to meet the minimum requirements; that is to fill the lubricators with oil and it is possible for a meter reader or line walker to assume the operation of these units in addition to his other duties. The lubricating oil requirements over the past year have averaged only one quart of oil per day per machine, or a cost of three quarters of one mill per mcf. Complete power costs are given in Table No. 2 and show that the power requirements varied from a maximum of .026 cents per thousand cubic feet to a minimum of .0164 cents or an average of only .0220 cents per thousand cubic feet. The amount of gas pumped was measured by means of an orifice meter and the power requirements taken from bills rendered.

Fixed charges have been estimated on the basis of an expected life of the machinery of 10 years and a return of 5 per cent interest. The experience of the past year's operation indicates that the compressors will have a life at least as long as that of the motors, and possibly longer. A life of 10 years is not unreasonable to expect of an electric motor, even though it is not given the best supervision.

The maintenance costs over the past year have been exceptionally low, consisting of replacing one set of vanes at a cots of $5.62, including both labor and material. These low costs cannot be expected over the full life of the machine, but even after a number of years should not exceed 10% of the original cost, or $600 per year. This charge would only make the cost of pumping gas 2.94 cents per m.c.f. as against the actual cost of 2.71 cents per m.c.f. as shown in Table No. 2.

For a period of 62 days at the first part of 1943, the total gas pumped amounted to a little over 44,000,000 cubic feet. It has been estimated that without the assistance of this unit, only a small percentage of the 25 wells it pumps could have fed into the line. Even these would have fed for only 8 to 10 hours on each of approximately 12 days for a total delivery of 4,000,000 cubic feet. On the basis of this estimate, made from recorded pressures, it would have been possible to take only 25,000,000 cubic feet from these wells in the past year instead of a little over a quarter of a billion cubic feet. When it is considered that 225,000,000 cubic feet of this gas would otherwise have been unobtainable, it can be said to be very cheap gas at twice the cost of procurement.

A reciprocating type of compressor, driven by a gas engine of the conventional design, and of a like capacity, would cost something like $150 per horse-power to install. The costs for 100 installed horse-power would be distributed roughly as follows: $7500 for engines and com-

(Continued on page 74)

TABLE NO. 3

Approximate Operating Cost of 100 H.P. Gas Engine Plant Based on Pumping 250,000 M. c. f. per Year

	Total Yearly Cost	Cost per M. c. f.
Labor	$2,930.00	.01172
Supplies & Expense	608.00	.00243
Maintenance	250.00	.00100
Fuel	2,100.00	.00840
Out of Pocket Cost	$5,888.00	.02355
Fixed Charges on $15,000 (5% Interest & 15 year life)	1,444.00	.00578
Total Cost	$7,332.00	.02933

Coatings Useful for Distribution Systems

By

Kirk H. Logan

National Bureau of Standards
Washington, D. C.

INCREASING shortages in manpower and materials and increasing operating costs make it essential that distribution men conserve pipe in the maintenance and extension of the system under their control. One means of economizing is the intelligent use of pipe line protection. The purpose of this paper is to consider what has been established regarding protective coatings and to call special attention to data applicable to distribution systems.

Two facts regarding protective coatings have impressed the writer. (1) The changes in pipe protection practice have been largely improvements in coating materials and practices rather than the introduction of things radically different and (2) many pipe line operators are not availing themselves of the facts at their disposal.

It seems worth while, therefore, to first briefly summarize the data which the activities of the American Gas Association and the American Petroleum Institute have collected through their research associates insofar as it is applicable to distribution systems and then to consider the additional facts which have developed since the work of these research associates, with respect to pipe coatings, was discontinued.

In 1928 both the American Gas Association and the American Petroleum Institute started studies of pipe coatings. Ewing, who directed the A.G.A. studies buried four specimens of each of 42 coatings applied to 2-foot sections of 2½ inch pipe in 14 soils, and removed one specimen of each coating from each site at the end of approximately 0.75, 2.4, and 5.5 years. The fourth set of specimens has not been examined. Ewing[1] made four reports on this project. Scott, who conducted the A.P.I. coating research, buried three specimens of each of 46 coatings, applied to 2-foot sections of 3-inch OD pipe at each of 16 test sites, two of which were abandoned before the completion of the tests. He also applied 16 coatings to 60-foot sections of pipe lines, but no one line coating was tested at more than 12 sites. Since the sites differed in destructiveness to coatings, all of the data on the line coatings are not comparable. The lighter coatings were tested at the less destructive sites. Scott[2] made four reports on this work but the final inspection and report[3] was made by the writer with the assistance of Scott and several pipe line engineers and coating technologists after the coatings had been in the ground about ten years. Reports on the final inspections were published in 1940 and 1941.

Presented at American Gas Association, Technical Section, 21st Annual Distribution Conference, Hotel Statler, Cleveland, Ohio, April 18-19, 1944.

The Results of Coating Tests

The men concerned with the planning of the tests and inspections worked together and their conclusions, though differing in details, are generally similar. Ewing pointed out that in the A.P.I. tests, after exposures of about 4 years, the line coatings applied by hand in the field were in every case less effective than similar coatings applied to small diamter pipe at a central plant. He advised against hand field-applications. He stated that any organic reinforcement was a weakness, emphasized the destructive effect of soil stress, and advocated the use of a shield over the coating to reduce the effect of soil stress. Both he and Scott noted that after 5½ years or less no coating under observation prevented all corrosion at all test points. The writer of the final report had the advantages of examining coatings approximately twice as old as those of Ewing or Scott, and line coatings of twice the area examined on previous occasions. He paid attention chiefly to the condition of the pipe beneath the coating on the theory that this was the best criterion for the effectiveness of the coating.

A review of the several reports on the A.G.A. and A.P.I. tests indicated that there was a continued deterioration of the coatings as indicated by increased numbers of holes in the coating, increased electrical conductance, and increases in the number and depths of pits beneath the coatings. The conclusion must be reached that although many of the coatings greatly reduced the amount of corrosion during the ten-year test, none of them would prevent corrosion indefinitely; indeed no coating prevented all corrosion at all test sites for ten years.

It follows from this observation that in computing the savings resulting from the application of a coating the engineer should not assume that the coating would eliminate repairs and maintenance indefintiely as Ewing[4] did for convenience in discussing the economics of coatings.

Although the period during which the poorer coatings will prevent leaks may be quite limited, the time during which the coating will reduce the amount of current required for cathodic protection is much longer.

The effectiveness of the A.P.I. coatings after ten years on pipe lines was determined largely by dividing the pipe line into one-foot lengths and recording the condition of each foot as unaffected, rusted, metal attack (pits less than 10 miles deep), or pitted, together with the depth of the deepest pit. All of these criteria are measures of the corrosivity of the soil rather than of the condition of the coating but they indicate the relative effectiveness of the coatings in the same soil if one may assume that the seriousness of the corrosion is a function of the duration of the exposure, i.e., an inverse function of the time the coating prevented corrosion.

In general, the effectiveness of the coatings as indicated by the percentages of coated one-foot lengths which developed pits or by the maximum pit depths was roughly proportional to the thickness of the coatings regardless of the kind of bitumen or the structure of the coating.

The percentage of pipe areas of the pipe which were pitted is perhaps the best criterion for the effectiveness since some greases and asphalts transmit enough moisture to permit slight rust to form but seem to re-

[1] *S. Ewing, Proc. A.G.A., 1309 (1930); 774 (1931); 741 (1933); 627 (1936).*
[2] *G. N. Scott, A.P.I. Coating tests—Progress reports I, II, III, IV. Proc. A.P.I. XI(4), 107(1930); XII(4), 134(1931); XIII(4), 114(1932); XV(4), 18(1934).*
[3] *K. H. Logan, Proc. A.P.I. XXI(4), 32(1940); XXII(4), 34(1941).*
[4] *S. P. Ewing, Corrosion Surveys for Pipe Lines. Proc. A.G.A. 846(1934).*

tard the progress of more serious corrosion, while the maximum pit depth is to some extent an accident which may be the result of some very local condition.

In the group of reinforced coatings in the A.P.I. line tests there were one grease and three asphalt base coatings reinforced by cotton cloth, a coal-tar and an asphalt base coating reinforced by rag felt, and a coal-tar and an asphalt-enamel reinforced by asbestos felt. The data on these coatings provide bases for studying the effects of the differences on base materials and on reinforcements but reliable conclusions are difficult to draw because all of the coatings differ in several ways. For example, the osnaburg fabric is thinner than either of the felt reinforcements and the asbestos felt is thinner than the rag base felt. Some coatings were made up of a single layer of fabric while others had two layers with bitumen between them. These multiple variables were unavoidable in a test based on coatings as furnished to and used by pipe-line operators. A hand-applied, asbestos felt shielded, coal-tar enamel containing some asphalt appeared to be superior to a shop-machine-applied coating consisting of two coats of coal-tar-asphalt enamel, although the latter coating was nearly three times as thick.

With respect to the percentage of pitted pipe areas a machine-applied asbestos-felt reinforced coal-tar-asphalt enamel was almost equal to a hand-applied rag-felt coal-tar enamel similar in construction but twice as thick. A ½-inch thick machine-applied asphalt-mastic coating was far superior to any of the other coatings by any of the criteria used by Ewing, Scott or Putnam. This coating was applied as a spiral wrap and occasionally water entered at the seams. It is now extruded around the pipe and is seamless except where sections of pipe are joined. The applications of two different coal-tar-asphalt enamels resulted in smaller percentages of pitted pipe than a somewhat thicker straight coal-tar enamel. These data seem to indicate that the prohibition of any asphalt in coal-tar enamels which frequently occurs in coating specifications is unjustified.

In all of the comparisons cited the results can be explained in more than one way and in several cases the apparent relative merits of the material might have appeared different if other bases for comparison had been used.

In addition to conducting tests of coatings, Scott made extensive inspections of coatings applied to working lines and issued a tentative code of good pipe-line coating practice. He emphasized the fact that many coating failures were caused by faulty application or careless handling of the coated pipe.

Scott and Ewing conducted tests of rot-resisting properties and found that all organic fabrics exposed to an organic soil rotted within a year.

Recent Improvements in Coatings and Coating Practices

Many feel that because of the work of these men and others, ineffective coatings have been eliminated, and that because of the improvement in coating materials and practices, the data on the coatings in the A.G.A. and A.P.I. tests are obsolete. The chief additions to the materials field are coal-tar enamels less sensitive to temperature changes, detailed specifications for coal-tar enamel coatings, and the introduction of a transparent cellulose membrane backed by a fabric as a reinforcement for a grease coating. Some bacteriologists claim that such membranes are attacked by certain bacteria.

The new enamel referred to requires a different technique for its application. The effectiveness use of the specifications for the new coal-tar enamels requires close control of all apparatus and testing procedures and some laboratories have had difficulty with their tests. While it seems probable that the improvements mentioned above together with the use of electrical inspection and greater care in the application and handling of coatings and coated pipe have resulted in better protection neither experience nor tests are available which show definitely the extent of the improvement.

Two reports of tests of recent asbestos-felt reinforced coal-tar enamel coatings have come to the writer. One report on a coating with which extraordinary care was taken to secure a coating virtually free from pinholes showed that the electrical resistance to ground of all of the 7 sections into which the coated pipe was divided by insulating joints decreased to from 30 to 1 percent of the original values within 4 years. The sections differed by a ratio of 30 to 1 in both their original and final resistances. The section which originally had the highest resistance had one of the lowest resistances four years later. The greatest changes in resistance occurred within the first year. Three out of five coatings reported on by another engineer showed similar variations in the resistances of different sections of the lines and little change in resistance after the first year. Part of the apparent stability of the resistances of the old coatings may be due to the fact that the measurements include the resistance of the soil and perhaps other resistances. When the resistance of the coating is high these are negligible but when the coating resistance becomes low any change in it is obscured by the other resistances included in the measurement.

The satisfactory application of hot coatings requires a clean, dry pipe. Occasionally conditions arise under which the elimination of moisture is very difficult. The use of a reinforced grease coating has been suggested for such conditions and one manufacturer recommends a transparent cellulose membrane cemented to some thicker fabric as the reinforcement. Few data on long-time exposures of such coatings are available. An extensive user of cement coatings has reported satisfactory results except for an apparent acceleration of corrosion just beyond the coated section. It seems probable that the alkali in the cement makes the coated pipe cathodic with respect to the adjacent uncoated pipe. Insulating joints or coating the entire line might eliminate this trouble.

There have been big improvements in machines for cleaning pipe and applying coatings, and these machines produce better appearing coatings. Facilities for testing coatings are better. High-voltage apparatus for locating pinholes was introduced soon after the A.G.A. and A.P.I. tests were started. The early apparatus lacked voltage control and it was difficult to apply the test to all of the coatings. Pinholes were missed. Sometimes too high voltage was applied at one point too long and the coating was injured. Recently Stearns[5] has developed a rather elaborate piece of apparatus which operates at about 8000 volts and cuts off the current as soon as a pinhole has been located. The voltage is applied by a spiral coil of wire which surrounds the pipe, and both visual and audible signals are given when a spark passes through a hole in the coating. Trials have shown that this apparatus discloses many holes in coatings not located by older apparatus. It is doubtful whether any of

[5] *D. E. Stearns, Electronic holiday detector. Fifth NBS Underground corrosion conference. (1943).*

the high-voltage apparatus will locate thin spots in coatings though Stearns[5] claims his apparatus will locate pinholes in reinforced coatings. Pearson[6] has gone a step further and invented a machine which will locate holidays, pinholes and low-resistance areas in buried coated lines from the surface of the ground, making it possible to determine the condition of a coating without excavations. The apparatus works satisfautorily only when the line has been buried long enough for moisture to enter the holes, or be absorbed by the coating.

It appears from the above statements that the possibilities of securing better protection for pipe lines have greatly improved. The extent of the improvement in coatings as they are actually applied has been shown by rather few data.

Several reports on recently applied coatings indicate that the pipe line with a continuous coating is still rare, and pipe-line operators seem to be reluctant to determine just how good their coatings are. No doubt this is partly because of the press of more urgent work and partly because there is little that can be done about a defective coating which is in the ground except perhaps to apply cathodic protection.

A few tests in Texas cities indicate that the restricted aeration of soils beneath pavements is favorable for the development of the anaerobic bacteria which are sometimes destructive to pipe. The action of these bacteria may partly explain the accelerated corrosion often observed at points where pipe lines cross highways. Other tests indicate that the hydrochloric acid test for sulfate reducing bacteria should be used with caution in cases where the soil is saturated with gas leakage. The gas may add sulfides to the soil.

[6] *J. M. Pearson, Electrical examination of coatings on buried pipe. Petroleum Eng. 12 No. 10 (mid-year number), p. 82(1941).*

Application of Coating Data to Distribution Systems

We may now summarize the data with respect to gas distribution systems.

There are several differences between cross-country pipe lines and distribution systems in towns and cities. Some of these are favorable to the latter. The short hauls usually involved and the favorable conditions for the proper application of coatings at a central plant seem to make a coating applied by machine at a central plant advisable under many conditions. Two general types of coatings seem worthy of consideration, (1) the asphalt-mastic, (2) a reinforced or shielded coal-tar enamel preferably of the so-called plasticised or water works enamel type. While the mastic coating has been used chiefly on cross-country lines there appears to be no reason why lines so coated cannot be tapped if the pipe wall is sufficiently thick. If the pipe wall is so thin that a saddle must be used to attach the service it should be possible to remove the coating for this purpose though this is somewhat difficult and some injury to the coating may result. It is quite possible to satisfactorily patch the coating at joints and presumably at other places. The plasticised enamel has been used chiefly on water lines but there seems to be no reason why it would not serve as well on gas lines. Three or four prominent coating manufacturers produce this type of enamel and Bureau of Standards tests indicate that any of the coatings which meet the A.W.W.A. specifications will serve equally well if equally applied to a pipe line.

Because reinforcements are seldom entirely water-proof and may serve as a wick to carry moisture into a coating, the writer prefers a shield to a reinforcement if the thickness of the bitumen is maintained. However, reinforcements are in more general use probably because it is easier to build up a thick coating by means of the reinforcement and because the outer layer of bitumen tends to keep moisture out of the fabric. Since the shield will be exposed to the action of bacteria it should be inorganic. The A.P.I. tests indicate that the shield should be permanent and rather stiff. The coating should be tested for pinholes and abrasions at the last practical moment before it is placed in the trench, preferably by some machine such as the automatic pinhole detector.

Notwithstanding the care which is taken to prevent pinholes and injuries the coating will not be free from them. Data are not available to justify a definite statement as to what should be done about this. Those who like to figure may consider possible solutions to the following corrosion prevention problems.

(1) Since in most soils there is a marked decrease in the rate of corrosion of iron and steel as the period of exposure increases, it might be worth while to determine whether the cost of additional metal sufficient to make the pipe wall thickness greater than the probable depth of the deepest pit which might develop within the service life of the pipe is less than the cost of a coating which would prevent corrosion of a lightweight pipe during the same period.

(2) The comparative cost and effectiveness of coatings and cathodic protection by means of zinc as it is being tried in Houston.

(3) The reduction in maintenance costs by the location of weak spots in coatings by means of the Pearson coating tester and their subsequent repair. So far as the writer knows the apparatus has not been applied to coatings under pavements. These problems might make good projects for a corrosion committee.

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RECENT COURT DECISIONS
Affecting Gas Utilities

What Price "Wrongful" Enforcement of Cut-Off Rules By Gas Company

By
Leslie Childs

CONCEDEDLY, a gas company has the right to enforce reasonable cut-off rules in dealing with its customers. And where service is disconnected in accordance with such rules, an aggrieved customer will rarely have any recourse against the company for resulting injury or damages.

On the other hand, a gas company acts at its peril when enforcing cut-off rules, in respect to its legal right to take such action. And if such action proves wrongful, liability for resulting injury may accrue. Of course, cases of this kind will usually turn upon their facts, but as illustrations of the importance of care in this phase of management the following cases are worthy of review.

Company Cuts Off Service

In a recent case, the defendant, a gas company, cut off the plaintiff's service through mistake or inadvertence, the details as to this do not appear in the report. The weather was cold; rain was falling; plaintiff did not have a telephone, so left her house, suffering considerable exposure, in notifying the company and getting the service reconnected.

From this exposure, plaintiff contracted a cold and resulting sickness that required medical attention. In due time plaintiff brought the instant action against the defendant for damages. The trial court rendered judgment for plaintiff for $500. The defendant appealed and the higher court in reviewing the record and in affirming the judgment, in part, said:

"There is ample evidence in the record to establish the fact that the defendant was negligent when it disconnected the plaintiff's gas service and that the plaintiff acted with reasonable prudence in leaving her house to report the fact to the defendant and in attempting to have her service restored.

"The evidence is also undisputed that she contracted a severe cold immediately following her exposure and that the doctor who was called to treat her was of the opinion that the exposure which she had undergone while her gas service had been disconnected had caused the disability which the plaintiff has sustained. * * *

"The negligence of the defendant in disconnecting the gas service having been admitted liability for any damage which proximately resulted followed. The trial court found upon the facts in favor of plaintiff and such finding is supported by the evidence shown in the record. * * * Judgment affirmed." (110 P. 2d 73)

So much for that case; let's take another of this kind.

Here the defendant, a gas company, because of a misunderstanding with the plaintiff, a customer, cut off the latter's service on a cold day in December. By the report, it appears, that the defendant under its consumer contract had no legal right to cut off the service when it did.

On the evening of the day in question, the plaintiff's son, 14 years of age, returned home from selling papers. The house was cold, plaintiff and her son had no where else to go so they spent the night in the house without heat. The boy contracted pneumonia from which he died a few days later.

Plaintiff then sued the defendant for damages on the ground that the defendant's wrongful cutting off of service was responsible for her son's death. The defendant, among other things, set up contributory negligence as a defense, and also contended that its act could not be held to be the proximate cause of the boy's death. The trial resulted in a judgment for the plaintiff for $11,500. The defendant appealed and the higher court in reasoning on the defenses set up, and in affirming the judgment, had this to say:

The Reasoning of the Court

"The evidence discloses that [plaintiff] was a very poor woman, and her only income was derived from her work for the relief committee and the earnings of her son as a newsboy. * * * There is no evidence whatever that [plaintiff] or her son had any other place where they might seek refuge from the cold. In the circumstances, it would be an unwarranted extension of the doctrine of contributory negligence to hold that * * * either the mother or son were guilty of such negligence. * * *"

Then as to the issue of proximate cause the court said:

"While the evidence shows that decedent was exposed to cold and inclement weather while selling papers on the afternoon of the 6th, [day service was cut off] there is nothing to indicate that pneumonia began to develop until the following day and after he had remained in the cold room all night. The attending physician gave as his opinion that the pneumonia which resulted in decedent's death was caused by his remaining in the cold room all night. This, in connection with other proven facts and circumstances, made an issue as to whether the alleged negligence of [defendant] was the proximate cause of the disease resulting in decedent's death. * * * Judgment affirmed." (78 S.W. 2d 21)

Conclusion

The foregoing cases were well reasoned by the courts and the holdings announced are supported by the weight of authority on the question involved. This authority taking the position that, while a gas company has the unquestioned right to enforce reasonable cut-off rules, it may be held liable for the proximate injury or damages resulting from a wrongful enforcement thereof.

In the light of which, gas company executives charged with this phase of management may well act with caution in situations of this kind. A slip-up here may indeed prove costly. And, as examples of liability possibilities where cut-off rules are, through mistake or otherwise, wrongfully applied, the cases reviewed are of force and value.

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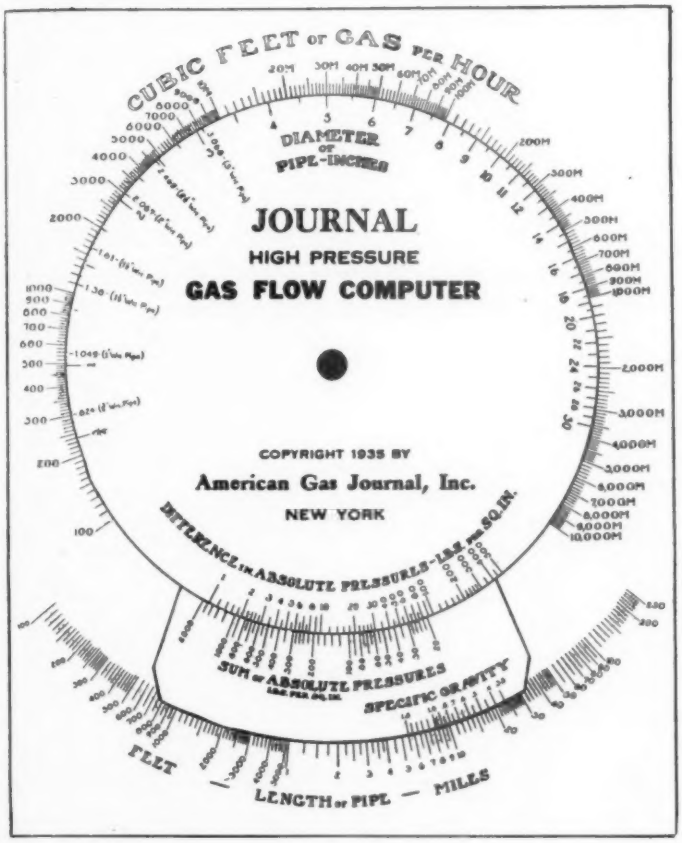

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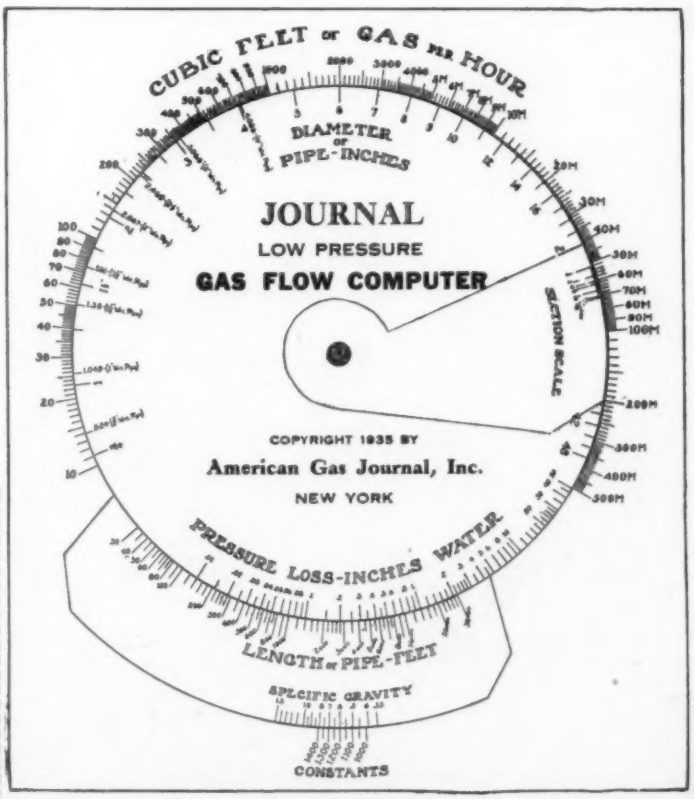

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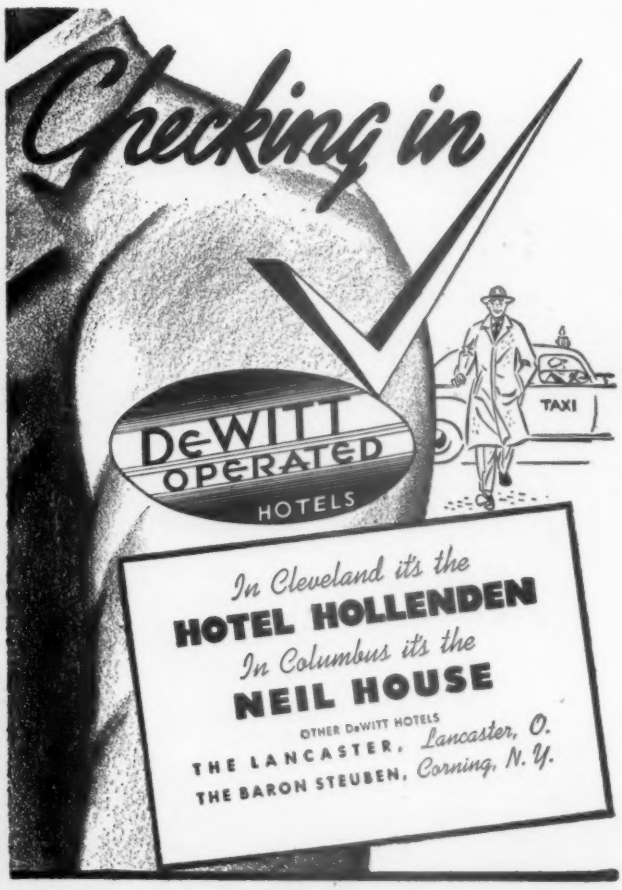

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News of the Gas Industry

New Members Elected to General Committee Southwestern Gas Measurement Short Course

The General Commiteee of the Southwestern Gas Measurement Short Course met in Oklahoma City recently to elect new members and to transact other business. Mr. Max K. Watson, General Chairman, presided. Mr. George E. Greiner, Phillips Petroleum Company, Bartlesville, Oklahoma, was elected as a member from industry to replace Mr. G. W. McCullough, ex-officio member. Mr. B. F. Worley, United Gas Corporation, Houston, Texas also from industry, was elected to replace Mr. R. J. Sullivan who resigned. Mr. Lloyd L. Jordan was elected to represent the Arkansas Oil and Gas Commission, and Mr. L. B. Taylor was elected to represent the Kansas Corporation Commission.

After the election, considerable time was spent in discussing the program of the forthcoming short course which will be held at the University of Oklahoma, Norman, Oklahoma, June 6th to 8th. A tentative list of lecturers and instructors was drawn up and Mr. Earl Kightlinger, Chairman of the Program Committee was instructed to invite each person selected, to participate in this year's course.

Mr. E. C. McAninch reported on the activities of the Practical Methods Committee and was instructed to continue with his studies and if possible have a report ready for distribution in June. It was the unanimous opinion of the General Committee that the proceedings of this year's course should be published in bulletin form. Mr. R. M. Scofield is Chairman of the Publications Committee. The Chairman of the Exhibits Committee, Mr. W. H. Woods, stated that most of the manufacturers who have participated in the past are making up educational exhibits for this year's short course.

Pennsylvania Gas Assn. Holds Post-War Symposium

The 36th Annual Meeting of the Pennsylvania Gas Association was held at the Benjamin Franklin Hotel, Philadelphia, on May 2nd.

Following the report of the president W. G. B. Woodring, operating manager of Allentown-Bethlehem Gas Company, at the morning session, R. D. Calkins, Dean of the School of Business, Columbia University, spoke on "Post-war Economic Conditions."

Ernest R. Acker, President of American Gas Association addressed the members at luncheon on "The Gas Industry in the Post-war Period."

The afternoon session, presided over by Frank H. Trembly Jr., included addresses by Hudson W. Reed, President of The Philadelphia Gas Works Company on "Maintaining the Post-war Initiative," and by H. Carl Wolf, President of The Atlanta Gas Light Company on "Customer Relations During the Post-war Period."

A banquet closed the program with addresses by Alexander Forward, Managing Director of the A.G.A. and by Edmund Collins, Jr.

Front Row, left to Right: James L. Griffin, Northern Natural Gas Company, Omaha, Nebraska; Miss Kate A. Niblack, Oklahoma Utilities Association, Oklahoma City, Oklahoma W. H. Woods, Gulf Oil Corporation, Houston, Texas; Max K. Watson, Canadian River Gas Company, Amarillo, Texas; Earl Kightlinger, Arkansas Louisiana Gas Company, Shreveport, Louisiana; W. H. Carson, Dean, College of Engineering, University of Oklahoma, Norman, Oklahoma; R. M. Scofield, Lone Star Gas Company, Dallas, Texas.

Back Row, left to right: E. C. McAninch, Oklahoma Natural Gas Company, Tulsa, Oklahoma; E. L. Stark, Foxboro Company, Dallas, Texas; George E. Greiner, Phillips Petroleum Company, Bartlesville, Oklahoma; C. E. Terrell, Southern Natural Gas Company, Birmingham, Alabama; Lloyd L. Jordan, Arkansas Oil and Gas Commission, Eldorado, Arkansas; W. R. McLaughlin, Pittsburgh Equitable Meter Company, Dallas, Texas; C. A. Gibson, Cities Service Gas Company, Bartlesville, Oklahoma; L. B. Taylor, Kansas Corporation Commission, Wichita, Kansas.

CONVENTION CALENDAR

May

2 *Pennsylvania Gas Association* Annual Meeting. Philadelphia, Pa.

11-13 *American Gas Association, Natural Gas Dept.* French Lick Springs Hotel, French Lick, Indiana.

15-16 *Indiana Gas Association Annual Convention.* Hotel Lincoln, Indianapolis.

19-20 *Gas Meters Assn. of Florida and Georgia,* Miami Beach, Fla.

June

5-7 *Advertising Federation of America,* Annual Meeting Hotel Sherman, Chicago.

6-7 *American Gas Association Joint Production and Chemical Committee Conference.* Hotel Pennsylvania, New York, N. Y.

6-8 *Public Utilities Advertising Association,* Annual Meeting Palmer House, Chicago.

6-8 *Southwestern Gas Measurement Short Course,* University of Oklahoma, Norman, Okla.

8 *Canadian Gas Association's 37th Annual Convention,* Royal Connaught Hotel, Hamilton, Ontario.

8-9 *Midwest Industrial Gas Sales Council,* Peoria, Ill.

27 *Conference on the Operation of Public Utility Motor Vehicles,* Bellevue-Stratford Hotel, Philadelphia, Pa.

Hamill Becomes Manager of Citizens Gas Company

W. H. Hamill, Vice-President and Manager of Crisfield Light and Power Company, resigned April 15th, to accept management of Citizens Gas Company, Salisbury, Md., which also operates the Sussex Gas Company of Seaford, Delaware.

Mr. Hamill also resigned as Vice President of Atlantic Gas Corporation of Philadelphia, also as Vice President of Pennsylvania and Southern Gas Co. of Philadelphia, Pa.

He was a Director of Chestertown Gas Co., Chestertown, Md. and Elkton Gas Co., Elkton, Md., as well as Vice-President of Elizabeth and Suburban Gas Company, Elizabeth City, N. C.

He was associated with N. Henry Gellert for many years prior to Mr. Gellert's assuming the Presidency of Seattle Gas Co. in November, 1943.

New Gas Water Heater Standards Available

Approval requirements for gas water heaters adopted as American Standard by the American Standards Association on February 23, 1944, are now available in printed form. They are effective as of January 1, 1944.

Principal changes in the construction features incorporated in this edition involve required compliance of various commonly used accessories with latest American Standard listing requirements for such devices. Gas valves, thermostats and temperature and pressure relief devices constitute outstanding examples.

Bringing the water heater standards in line with performance tests for other types of gas appliances, normal test pressure for use with manufactured gas has been increased to 6 inches. In addition, provisions for testing and certification of water heaters for use with mixed gases now being distributed in various territories have also been incorporated.

Other important changes in performance tests are new provisions for testing insulated gas water heaters so that they may be installed flush to walls in modern homes.

Copies of these American Standards may be obtained from the American Gas Association Testing Laboratories, 1032 East 62nd Street, Cleveland 14, Ohio.

A.G.A. Bulletins on Domestic Cooking and Burner Research

Two more bulletins, resulting from the accelerated program of fundamental research being conducted by the American Gas Association at its Testing Laboratories, are now available to those interested. Covering special phases of domestic cooking and burner research, their initial distribution was recently completed.

The first, "Single Point Flash Tube Ignition of Oven and Broiler Burners," is known as Research Bulletin No. 21. It is a sequel to Bulletin No. 17 which presented a comprehensive study of the fundamentals of flash tube oven ignition using manufactured gas. The new bulletin extends the study to the field of natural gas, the ultimate goal being design of flash tubes providing effective ignition with natural, mixed and manufactured gases.

The second bulletin, "Primary Air Control Devices for Atmospheric Gas Burners," is designated Research Bulletin No. 22. It presents extensive data covering studies of different means of controlling primary air injection with Bunsen burners and tests made to determine the relative merits of various types of primary air adjustment devices in resisting reduction of initially regulated air-gas mixture ratios as a result of dust and lint stoppage.

Both bulletins were prepared and approved under the sponsorship of the Committee on Domestic Gas Research of which Everett J. Boothby is Chairman and F. M. Banks, Vice-Chairman.

Public Service Co., Indiana Elects Directors

Eight directors were re-elected and one new member, Anton J. Hulman, Jr., Terre Haute business executive and civic leader, was elected to the board of the Public Service Company of Indiana, Inc. at the 1944 annual meeting of shareholders.

Directors re-elected to serve until the next annual meeting, are: Robert A. Gallagher, Dudley R. Gallahue, William C. Griffith, Kurt F. Pantzer and Louis B. Schiesz, of Indianapolis; William C. Freeman, Chicago; Peirce C. Ward and Hugh A. Barnhart, of Rochester, Ind.

Mr. Hulman, who takes the place of Stuart J. Barrett, of Chicago, on the board, is president of Hulman and Company, Terre Haute. He is president and director of the Richmond (Indiana) Gas Corporation; vice-president of the Princeton Mining Company; he is a director of Hulman Foundation, Indiana State Teachers College Foundation, Terre Haute First National Bank, Citizens Independent Telephone Company and Terre Haute Brewing Company, and is a member of the board of trustees of the Indiana State Farm.

Officers of Public Service Company of Indiana are: Mr. Gallagher, president; Mr. Schiesz, first vice president; David P. Fardee, vice president and comptroller, Garland J. Oglebay, vice president; Edwin J. Booth, secretary and Paul Stark, treasurer.

W. J. Kelly Elected Director P. S. Co. of No. Illinois

At the annual meeting of stockholders of the Public Service Company of Northern Illinois held April 4th, William J. Kelly, President of Kelly O'Leary Steel Works, was elected a director to fill the vacancy caused by the death of Bernard E. Sunny.

The other directors, all re-elected, are Britton I. Budd, James D. Cunningham, Albert B. Dick, Jr., Stanley Field, Charles Y. Freeman, Joseph H. King, T. Albert Potter and John Wentworth.

Washington Gas & Electric Makes Personnel Changes

The Washington Gas and Electric Company, with headquarters in Tacoma, and serving manufactured and butane air-gas in twelve western Washington cities and towns, recently announced several personnel changes.

F. R. Merris has been appointed General Manager of the company after serving as Secretary and Treasurer since 1930. Merris has a background of 32 years in the utility field and before joining the Washington organization was with the Ohio Electric Power Company in Sydney and Columbus, Ohio.

M. C. Hancock, formerly Manager of the company's Aberdeen division, became Distribution Superintendent of the Tacoma division succeeding J. H. Harris, who died in January. Harris had been associated with the gas company for 33 years. E. J. Renz succeeds Hancock at Aberdeen.

Leonard Hale, of the Tacoma Commercial Department, has been appointed Manager at Olympia succeeding George Earsley, who has entered the armed services.

Potter is Chairman of Sales Division N.E.G.A.

H. Vinton Potter

H. Vinton Potter, sales manager of the Fall River Gas Works Company, Fall River, Massachusetts was selected to be chairman of the sales division of the New England Gas Association. The meeting was held in Boston.

Potter was formerly associated with the Oklahoma Natural Gas Company, Tulsa, as merchandise sales and advertising manager. He was also merchandise manager of the Blackstone Valley Gas and Electric Company, Pawtucket, R. I.

Minneapolis Syndicate Acquires Manitowoc Property

It is reported that the Wisconsin Fuel & Light Co., Manitowoc, has been sold to a Minneapolis syndicate headed by Harry K. Wrench, president of the Minneapolis Gas Light Co. The property was taken over by the new owners April 1. President and treasurer of the company will be Harry Wrench, Jr., now in the army, with William O'Donnell, Minneapolis, as vice president and general manager.

THE STACEY MANUFACTURING CO.
Engineers Fabricators Constructors
• Gas Holders • Gas Plant Equipment • Steel Plate Construction •
GAS HOLDER INSPECTION SERVICE
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93
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Years

WPB Approves Pipe Lines in So. California

WPB has approved construction of natural gas pipe lines to run from the La Goleta dry gas field above Santa Barbara to Los Angeles, that will cost about $4,000,000. Companies involved are Southern California Gas Co., Southern Counties Gas Co., and the Pacific Lighting Co.

The project will enable the gas companies in Southern California to store large volumes of surplus gas in the natural underground reservoir at La Goleta during the summer months when gas consumption is low, and to utilize this surplus to meet peak loads in wintertime.

The plan calls for construction of a 16-inch line by Southern Counties Gas Co., connecting the La Goleta field with the company's Ventura compressor plant, a distance of 36 miles. Southern California Gas Co., will lay 55 miles of 18-inch pipe and 12 miles of 22-inch pipe, between Ventura and Los Angeles.

In addition to these jobs, Pacific Lighting Corp. proposes to enlarge its compressor plant and install a dehydration plant. Southern Counties will build a dehydration plant at Ventura and revamp its compressor station there.

Discuss West Texas-Los Angeles Natural Gas Line

Consideration is being given to the possibility of constructing a pipe line to transport natural gas from west Texas to the vicinity of Los Angeles, Calif. The project would cost $50 million and is still in the discussion stage as a long-range necessity to relieve the tightening supply-demand situation for natural gas now developing in the southern California region.

Officials of mid-continent petroleum companies have joined in a survey of the line's possibilities and the plan has been broached to the War Production Board.

Natural gas supply conditions in California, especially in the southern section of the state, are receiving increasing attention. Operating subsidiaries of Pacific Lighting Corp. have increased their annual handling of natural gas persistently during recent years. Gas volume for 1943 increased by 35 billion cu. ft.—23 per cent —over 1939. This includes gas supplied to San Diego Gas and Electric Co.

Tennessee Gas Arranges RFC Loan to Build Pipe Line

Tennessee Gas and Transportation Co., subsidiary of Chicago Corp., is arranging for a Reconstruction Finance Corp. loan of not more than $44 million to finance construction of a 1263-mile natural gas pipe line to transport gas from the area around Corpus Christi, Tex., to the Appalachian region. Total cost of constructing the line is estimated at $51 million, and at latest report the Tennessee company had entered into numerous contractual arrangements for purchase of a substantial part of the materials and for construction of the pipe line.

Pacific Gas and Electric Company Appoints Director of Home Economists

The Pacific Gas and Electric Company has announced the appointment of Miss Marguerite Fenner as the Director of Home Economics for its entire system. Miss Fenner has been serving the company for some six years as Appliance Counselor and Home Economist in the Sacramento Division and her success there has led to her promotion.

Miss Fenner holds a degree of B.S. in Home Economics from the University of South Dakota. Following graduation she served for one year as Home Service Director of the Mountain States Power

Marguerite Fenner

Company in Casper, Wyoming. She then transferred to the California-Oregon Power Company at Medford, Oregon, leaving that post to join the Pacific Gas and Electric Company's organization.

Miss Fenner will be in charge of the home economics department and will direct the work of a staff of home economists located in the various company divisions. Her appointment is evidence of the Company's realization of the great importance which will attach to this type of customer contact in the post-war period.

Miss Fenner is currently serving the Pacific Coast Gas Association as Chairman of its Home Service Committee. She recently organized and directed the program of the Association's annual Home Service Conference which took place in San Francisco on March 1 and 2.

Madison Voters Defeat Plan to Purchase Utility

By a margin of almost two to one, Madison, Wisconsin voters rejected April 5 a proposal to purchase the Madison Gas and Electric Co. for a sum not to exceed $11,500,000. The vote was 12,940 to 6995. Proponents failed to carry a single ward.

The balloting climaxed one of this city's most heated spring election campaigns, both sides engaging in vigorous bids for votes on the radio and in the two newspapers.

WPB Approves Pipe Line for Carbon Black

Plans to construct a 60-mile natural gas pipe line to run to carbon black plants in the Texas Panhandle area were approved by the War Production Board on April 12. It is estimated the new line will supply enough gas to produce an additional 30 million pounds of carbon black a year.

The proposed line will be large enough to supply at least 60 million cubic feet of gas a day. It was reported to WPB that an additional 100 million feet of gas a day was available in west Texas area. The increased production would be enough to meet the 1944 requirements of the rubber program.

Independent Petroleum Assn.

At the mid-year meeting of the board of directors of the Independent Petroleum Association of America in Bradford, Pennsylvania, April 27, 28, and 29, Ralph T. Zook of Bradford, president of the association, and Russell B. Brown, general counsel, addressed the directors at a dinner meeting April 28, at the Pennhills Club.

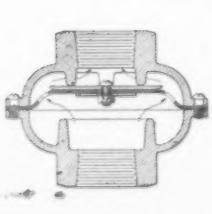
Mr. Zook spoke on "Cooperate When Possible—Fight When Necessary." Mr. Brown's subject was "What We Should Expect From Washington."

The three-day meeting placed emphasis on secondary oil recovery operations and a national oil policy.

Field trips for inspection of secondary recovery plants in the Bradford area were held on April 27 and 29.

One of the highlights of the meeting was an address by Raymond Moley, who spoke on "The Political Outlook" at a luncheon meeting Saturday noon. E. C. Moriarty of Wichita, Kan., presided at the luncheon.

Pressure Controls for Gas and Air



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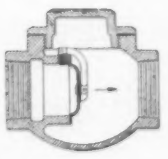

NORWALK VALVE COMPANY

85 Spring St. South Norwalk, Conn.

Cooper and Weymouth Retire from A.G.A. Chairmanships

Long standing teamwork of two pioneers in the conduct of organized research in the natural gas industry was ended last month with the announcement of the retirement of Howell C. Cooper and Thomas R. Weymouth as chairman and vice-chairman respectively of the Main Technical and Research Committee of the Natural Gas Department of the American Gas Association. Thus closed one distinguished chapter in the history of natural gas research which spanned more than 22 years of active coordinated effort.

Both men retired from active business affiliation several years ago although continuing in important consulting work. Their personal contributions and the achievements of the Main Technical and Research Committee have been widely recognized throughout the gas industry. Both Mr. Cooper and Mr. Weymouth have received the industry's highest honor, the Charles A. Munroe Award, for their research leadership and their many other contributions toward the advancement of the industry.

Miss Moomaw Appointed Secy. Natural Gas Dept. A.G.A.

Miss Honoria B. Moomaw, acting secretary of the Natural Gas Department of the American Gas Association, has been advanced to secretary. Miss Moomaw was appointed acting secretary of the Natural Gas Section on June 15, 1942. When the Association reorganization became effective earlier this year and the Section became a Department, she continued as acting secretary.

Synthetic Rubber

More than 100,000,000 pounds of general-purpose rubber—50,000 tons—have been produced in the government synthetic rubber plant in Louisville, Kentucky, by The B. F. Goodrich Company, it was announced recently by W. S. Richardson, general manager of the company's Chemical Division.

The Kentucky plant began operations in November, 1942, and by March 21 had turned out more rubber than the United States obtained last year from Latin America, Africa, and Mexico according to Richardson.

"One of the major units in the government rubber-making program, but not the largest, the Louisville plant is currently exceeding its annual rated capacity of 60,000 tons of rubber," Richardson declared.

B. F. Goodrich operates two other large synthetic rubber plants in addition to Louisville, and was responsible for the construction of government plants having an annual capacity of 255,000 tons, including Port Neches, Texas, the largest in the world, described in the January issue of the JOURNAL.

W. W. Scull has been appointed manager of the plant being operated at Port Neches, it is announced by William I. Burt, general manager of plants of the company's chemical division.

Coast Counties Gas and Electric Announce Personnel Changes

R. L. Hayden, Manager of the Contra Costa Division of Coast Counties Gas and Electric Company, has been appointed Sales Manager in charge of all gas and electric sales activity. This appointment will relieve H. W. Edmund of sales responsibilities which he has carried on for the past year and a half in addition to his duties as Vice President and General Manager.

After May 1, Mr. Hayden will be at his headquarters in the General Office of the company in Santa Cruz.

The Manager's position in Contra Costa will be filled by Clifford R. Hayden, brother of R. L., who is Manager of the Imperial Valley District. C. R. Hayden will in turn be succeeded by Mr. Fred Hix, Manager of Westside Division. Mr. Hix's successor is Mr. W. R. Snyder, Manager of Hollister District, and the new Manager in the Hollister District will be Mr. Wayne Matthews, formerly Assistant to the Chief Engineer in the General Office in Santa Cruz.

Irelan Is New President Cities Service Gas Co.

S. B. Irelan, who has been associated with various subsidiaries of Cities Service Co., for the last thirty-five years, has been elected president of Cities Service Gas Co., it was announced recently, following a meeting of directors at Bartlesville, Okla.

He succeeds H. R. Straight, who said his increasing duties as president of Cities Service Oil Co. would require all his time. A. W. Ambrose also has resigned as vice-president and director, but will continue as executive vice-president of the subsidiary.

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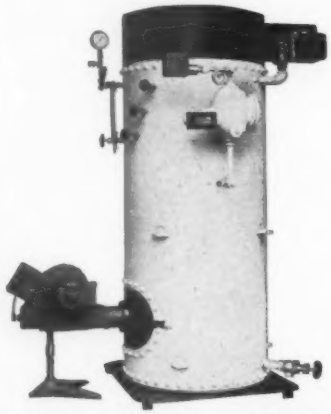
GAS — OIL BOILER
3 HP to 35 HP.



Burns natural gas or regular furnace oils with equal efficiency using same burner.

P. M. Lattner Mfg. Company
Cedar Rapids, Iowa

Corrosion Engineers Meet At Houston

Corrosion engineers from all over the United States and Canada gathered at Houston April 10-12 for the annual convention of the National Association of Corrosion Engineers. Many papers presented related to pipe line corrosion including the following:

"A Corrosion Bibliography," by W. P. Noser, Humble Pipe Line Co.; "A Field Experiment Utilizing Magnesium for Cathodic Protection," by G. R. Olson, United Gas Pipe Line Co.; Use of Zinc for Cathodic Protection," Committee report with H. W. Wahlquist, chairman; "Tap Changing Transformers for Cathodic Protection, by E. G. Goddard, Jefferson Electric Co.; "Proposed Methods of Detecting Internal Corrosion," by T. B. MacDonald, United Gas Pipe Line Co.; "Estimates of Corrosion Rates by Chemical Analysis," by E. A. Brown, Lone Star Gas Co.

"A Method for Studying Anodic and Cathodic Areas Under Cathodic Protection," by O. C. Roddey and L. R. Sheppard, Interstate Natural Gas Co.; "Tests on Buried Pipe Samples Showing Relation of Galvanic Currents and Potentials" by M. Miller, Ebasco Service, Inc.; "Basic Principles of Stray Current Control," by C. H. McRaven, War Emergency Pipe Lines, Inc.; "Coupling Bonding on Natural Gas Lines," by F. J. McElhatton, Panhandle Eastern Pipe Line Co.; Somastic Coating and Cathodic Protection," by Gordon N. Scott.

A. O. Smith Announces Welding Equipment Distributor for California

The A. O. Smith Corporation, Milwaukee, Wisconsin, announces the appointment of Pacific Metals Company, Ltd., as distributor in California, Nevada, and Arizona for "Smithway" Certified Electrodes, A. C. Welders, and other welding equipment. Substantial stocks of these nationally recognized products will be carried in Pacific Metals' warehouses at 3100 Nineteenth Street, San Francisco, and at 1400 South Alameda Street, Los Angeles.

R. S. Coffin Elected Pres. Bailey Meter Co.

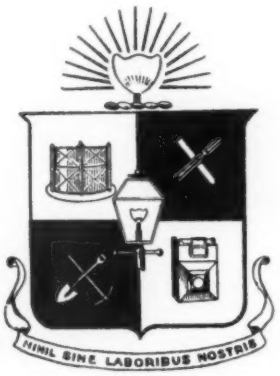
At a recent organization meeting of the directors of Bailey Meter Co., E. G. Bailey, former president and company founder, was elected chairman. Robert S. Coffin succeeds him as president.

Mr. Coffin, who has been vice-president since 1925, became identified with Bailey Meter Co. as treasurer at the time of its organization in 1916.

Other officers elected at this meeting are R. E. Wooley, vice-president, who has served in that capacity since 1927, and J. H. Black, secretary-treasurer.

Gild of Ancient Supplers Hold Sectional Meetings

Two Sectional Meetings of the Gild of Ancient Supplers were held on the morning of March 23rd, at Boston, which was presided over by New England Warden George Velte of the American Stove Company, and the other at New Orleans, La., held under the joint auspices of Southern Warden Dave Sharpe of the Roper Company, and Southwestern Warden Steve Day of the Barrett Company.



At both meetings there was the customary round-table discussion, but at the Boston Meeting Mayor Bartlett delivered a very fine talk, partly as a welcome to the new members of the Gild who were at the breakfast. He called particular attention to the fact that while the Gild Meetings are sometimes considered as purely social gatherings, yet there is a very real and sincere purpose behind the organization. He said that this was proven by the thirty Supplers who were on hand for the Meeting which was held at 8 o'clock in the morning.

Mayor Bartlett mentioned the intent of the Great Council to keep the membership of the Gild down—not to a point of exclusion, but to that point where the entire gas industry would recognize that to be a Suppler is to have a certain prestige. The Mayor pointed out that it was the duty of every Suppler to put forth some effort to make the Gild a worthwhile project.

The Gild is seven years old. Eighty-four months have zipped into history since seventeen veteran "Peddlers" lunched at Skytop and resoluted that we ought to have an association. Seventeen then, one hundred and seventy-six now.

To quote Mayor C. E. Bartlett, "Can it mean else than survival because in the turbulent present we draw strength, relaxation and inspiration from our association with one another."

Paul Holmes Becomes Sales Manager of National Radiator Co.

The National Radiator Co., Johnstown, Penna., has announced the appointment of Paul B. Holmes, as manager of sales of the heating division. He succeeds the late Charles L. Crouse.

Mr. Holmes has been with the company for 27 years. His first position was in the office of the Washington branch. Later he became a salesman in this territory and was promoted to branch manager in 1935.

New Manual on Meter Maintenace

Changes in meter shop personnel brought about by conditions of war make it essential that the most basic instructions in meter repairs be accessible. Therefore, the availability of the new Sprague Shop Manual No. 17, completely revised and replete with illustrations, comes at a most opportune time. Its step-by-step instructions through word and picture are so clearly defined that no other instructions are really necessary. The editors have wisely followed only the most universal methods employed by experienced and practical meter shop men throughout the world and it is believed that no shop is too small to economically manage its own repair work. Following is a partial summary of the manual's contents:

Meter Repairs—Standard, prepayment and curb; Proving Meters—Percentage of error tables, etc.; Diaphragm Oiling; Meter Tools; Meter Specifications; Meter Parts; Measurement at High Pressure; Complete new chapter on the repairing of Combination Meter and Regulator.

Copies of Sprague Repair Manual No. 17 may be had through any Sprague representatives or by writing directly to the Sprague Meter Company, Bridgeport, Conn.

A. O. Smith Corpn. Appoints Bart Southwest Gen. Mgr.

B. F. Bart, for many years with A. O. Smith Corp., formerly as assistant sales manager at Milwaukee, and for past several years in the Southwest where he devoted most of his time to government production work, has been made general manager for the entire Southwest, including government work and sales, with headquarters in the Esperson Building, Houston. His many friends will be pleased to learn of this advancement.

Personnel Changes at Pemco Corporation

The Pemco Corporation of Baltimore has announced a number of changes in their personnel.

R. L. Foraker has joined their Sales Staff and will cover the Chicago territory which includes Illinois, Indiana, Michigan, and Wisconsin. He is well known in the Chicago area having spent some twenty-two years in the porcelain enamel industry, most of which has been with Chicago companies.

S. S. Groglode has also become associated with Pemco Corporation. He will cover the state of Ohio, part of West Virginia, Indiana, and Illinois and Michigan.

Pemco also announces the advancement of O. L. Davis from Purchasing Agent to Assistant Works Manager. James Theodore has been advanced to the position of Buyer.

Gas Machinery Company Elects Officials

Orville Smith and K. W. Stookey have been elected Vice Presidents of The Gas Machinery Company of Cleveland, Ohio.

Mr. Smith has been doing legal work for the Company over a number of years and has also been associated with other gas understakings.

Mr. Stookey has been with the Gas Machinery Company for many years and is experienced in both the operation and construction of complete gas plants and Industrial Furnaces which the Company produces.

1944 Register of the Gas Industry—British

The 1944 edition of this annual published by Hallows & Slaughter, Ltd., 29 Grove Road, Leighton Buzzard, Beds., has been distributed.

It includes, as in former editions, a complete directory of gas undertakings in Great Britain, lists of Gas Associations, gas officials and holding companies.

The Technical Section of some 170 pages gives data on equipment, operation, distribution and utilization.

Magnesium. A 20 page booklet issued by Fisher Furnace Company, 5535 N. Wolcott Ave., Chicago, gives an outline of the growth of production of magnesium alloys in the United States in recent years and briefly describes the types of furnaces and fuels used in their production. Characteristics of the product are also given in brief. Copy of the booklet sent on request.

The Reliable Shut-Off for Street Mains

THE GOODMAN STOPPER

Now has the "Z" handle for easy manipulation. When locked in place it holds. Stopper cannot slip. Gas cannot pass. Adjusted in 30 seconds.

Ask for circulars on this and other distribution equipment.

Nearly a half century of service to the Gas Industry.

Safety Gas Main Stopper Co.
523 Atlantic Avenue, Brooklyn, New York

"Pemco" Personnel Changes

Colonel W. F. Rockwell, President of Pittsburgh Equitable Meter Company, has announced the following changes on the executive staff:

N. J. Kenny, formerly General Manager of the National Meter Division in Brooklyn, has been transferred to the home offices in Pittsburgh where he will serve as Assistant to Colonel Rockwell. Mr. Kenny has also been appointed Chairman of the Post-War Products Development Committee.

A. R. Whittaker, formerly Factory Manager of the National Meter Division, will assume the duties of General Manager and has been placed in complete charge of all functions at the Brooklyn factory.

Merriam Named Pur. Agt. Grand Home Appliance Co.

Ralph F. Merriam has been named to the post of purchasing agent for the Cleveland Co-operative Stove Company and its divisions, Grand Home Appliance Company and Cleveland Foundry Company, according to an announcement made recently by the firm's president, James Mitchell. Merriam succeeds Victor H. Gordon, now serving in the U. S. Army. The purchasing department is located at 2323 East 67th Street, Cleveland, Ohio.

Merriam has spent the past nine years with Grand Home Appliance Company, serving seven as district manager of the concern's Ohio and Pennsylvania territory and the last two years as assistant purchasing agent.

Change in Corporate Name

The Selas Company, Philadelphia, Pa., consulting end manufacturing gas engineers, announces official change of its corporate name to Selas Corporation of America. In the industrial gas utilization field Selas is particularly known for its development work in the use of precision ceramic parts in burner design to achieve new combustion results.

General Orders and Directives—Part 602—Bituminous Coal

602.391. *Schedules for distribution of bituminous coal.* Producers and wholesalers (including dock operators) are required to arrange their distribution schedules for the period April 1, 1944, to March 31, 1945, (1) so that first preference is given to by-product coal and other special purpose coal commitments, in a manner which assures that such commitments are met in full and are, ot the maximum extent practicable, met by regular equal monthly shipments (shipments by rail, river or tidewater should be spread through the entire year April 1, 1944, to March 31, 1945; * * *

602.393. *Conditions under which bituminous coal may be shipped, delivered or received.* No person shall distribute, ship, deliver or receive any bituminous coal except in accordance with the provisions of this regulation and other applicable regulations. Any person who distributes, ships, delivers or receives bituminous coal, except as provided in the regulations, may, to the extent necessary or appropriate in assuring the equitable distribution of bituminous coal, be precluded in whole or in part by SFAW from distributing, shipping, delivering or receiving bituminous coal.

Part 3285—Lumber and Lumber Products (Order L-335, Interpretation 1) Lumber Consumers Requirements

"War Production Board Order L-335 reflects the present shortage of lumber of all kinds and requires that large consumers file an application for their needs in the 2nd and 3rd quarters of 1944. Should you be planning on doing maintenance or repairs this Spring or Summer using sizable amounts of lumber for forms, etc., your total lumber requirements may bring you within the restrictions of this order. An estimate of your lumber needs should therefore be made immediately.

"If your requirements for lumber of all kinds, as defined in the order, during either the 2nd or 3rd quarters of 1944 for all purposes such as maintenance of structures, operating supplies, and minor plant additions, but excepting major plant additions such as authorized on Form WPB-2774, will call for the delivery of more than 50,000 board feet, then you must file an application *on or before April 25th;* otherwise, you are prohibited from accepting delivery of any lumber after that date. Operating divisions of a company regularly maintaining separate lumber inventories can be considered as separate units and each entitled to the amount of lumber permitted by the order.

"WPB Form 3640 must be used if it is necessary to make an application to receive lumber . . ."

Remote Control Valve. A 20-page bulletin issued by Grove Regulator Company, 1190-67th Street, Oakland, 8, California, describes in complete detail with many illustrations the Grove "Flex-flo" valve. These are designed for handling oil, water, chemical solutions, gases and air. Standard design is for pressures up to 200 p.s.i., but special valves are available up to 2500 p.s.i. Made in sizes 1½" to 12". Copy of bulletin on request.

Refractories. McLeod & Henry Co., Inc., Troy, New York, has issued a bulletin on three new fire clay brick products, namely, Hyex, Super-Hyex and Superam designed to supply the demand for fire clay bricks possessing greater spalling resistance, greater load bearing strength and greater volume of stability. All are made from specially selected Missouri flint clays, moulded with considerably higher than usual pressures and are burned from oversized green bricks at extremely high temperatures to completely shrink the shape to the desired size.

Refractory Coating

A new refractory coating, applicable to foundry and heat-treating fixtures, to prolong their life under intense heat, has been developed by the Neo Mold Company of Cleveland. The coating is known as "Neo-Kote—P 101." Typical of applications in which Neo-Kote is said to be especially effective are magnesium and aluminum melting pots, core baking boxes, loading racks for high-temperature furnaces and heat-treating fixtures of various types.

According to the company's chief metallurgist, who perfected the new formula, it greatly increases the number of heats to which such equipment can be subjected before breaking down from oxidation and flaking.

Magnesium-aluminum melting pot after treatment with "Neo-Kote—P 101". Reported to increase the life of such pots to as high as 50 to 100 heats.

"While the basic principle we use is not new," this official said, "our method, and the refractory surface produced, are results of our own metallurgical developments. In the application of this refractory coating to melting pots or crucibles used for magnesium, aluminum and bronze we have found definite improvement in the endurance of the equipment. In plants where such equipment was scaling and breaking down under a maximum of 25 to 30 heats, this treatment has commonly increased the serviceability to 50 or 60 heats. It is not unusual for treated pots to last 75 to 90 heats, and in rare cases, where workmen are more careful in handling equipment, as many as 100 heats."

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Man with engineering background having thorough knowledge of modern high and low pressure gas distribution practice, cleaning, dehydration, sizing of equipment, plant layout. Permanent position with large manufacturer. Write giving full transcript of experience. Box 132, c/o American Gas Journal, 53 Park Place, New York 7, N. Y.

Norton Company Appoints Henson Field Engineer

W. H. Henson has been appointed refractories field engineer by Norton Company, Worcester, Massachusetts. He will make his headquarters in Worcester and will do engineering work in all of the refractories territories. Mr. Henson has been with Norton Company for sixteen years and for the last thirteen years has been refractories engineer for the New England District.

Eugene A. Fischer has been appointed New England refractories engineer to succeed Mr. Henson. Mr. Fischer has been connected with the research laboratories and the refractories engineering department at Worcester, where he will continue to make his headquarters.

Connelly Opens New Pacific Coast Plant

Connelly Iron Sponge & Governor Company of Chicago, manufacturers of gas purifying materials and apparatus, has just announced the opening of their new Pacific Coast plant, located at 540 Bauchet Street, Los Angeles, California.

This plant was put into production in record time to supply the emergency gas purification needs of the Southern California Gas Company's Butadiene plant.

Ground was broken for the plant on March 25th, and the first shipment of Connelly Iron Sponge was delivered early in May. Mr. R. W. Stafford, Chief Engineer of the Connelly Company, has been on the West Coast for the past six weeks, devoting full time to planning, laying out, and putting the plant into production. The plant manager of the Connelly West Coast branch will be Mr. James J. Cuddihy, who has been with the Connelly organization for the past twenty-two years, working up through the plant to the position of Plant Superintendent at Chicago.

With the establishment of the West Coast branch, Connelly Iron Sponge & Governor Company is now in a position to furnish purifying materials and apparatus from coast to coast.

FOR SALE
TWO FERNHOLTZ PRESSES

Each now equipped with 50 cavity bronze mold for briquet (2½" diameter x 2¾") manufacture. Five ton per hour capacity. Complete with electric motor drive and transmission machinery. Condition good. Hoppers and screens also available. Complete description upon request to those interested. Price very reasonable.

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Butterfly Valves. A 36-page catalog describes a complete line of butterfly valves profusely illustrated with both manual and power operated valves for pressures from 15 to 900 psi. Contains detailed specifications, applications and descriptions of new type valves. Among the illustrated valves is a dual type, designed for a high pressure drop and small volume or a low pressure drop and large volume. A three-way butterfly valve for mixing and quick interchange service is also featured. The catalog is standard size 8½ x 11 and designated as Catalog No. 14-B. Available upon request. R-S Products Corporation, Wayne Junction, Philadelphia 44, Penna.

Industrial and Commercial Gas Load

(Continued from page 53)

able business. The other is the problem of the economics of supply, involving studies of the influence of factors such as load, volume of sales, and customer-location, on the cost of supplying service in various classifications. No enterprise that sells a variety of commodities or services to various classes of customers, through channels that involve complex facilities or operations, can permanently ignore these important economic problems of the market and the supply.

Studies such as these have proven valuable to the management of gas utilities, as guide to desirable policies in relation to marketing and pricing. Each gas utility has its own problems which may resemble those of other situations in some respects and may differ in certain others. The solution of these particular problems probably can be developed by the individual gas utilities in various ways. One successful method is the appointment by the management of what may be termed a "Marketing Committee," composed of representatives of the utility's various departments of operation. In such a committee the sales organization naturally has an important place. So has the department that deals with the company's costs, rates and economic problems. The purpose of the committee is to plan, develop and bring together, through what may be considered as sub-committees in the several departments of operation, all of the obtainable information that will throw light on the relation of the economics of marketing and the economics of supply. How and to whom the various phases of the problems should be assigned is not important in this discussion, since these matters will depend, in large measure, on the structure of the organization of the individual utilities and on the experience, competence and field of activity of the several members of the personnel. The important thing is that the equivalent of such a committee be established in the organization of any gas utility with problems of this kind.

In view of the diverse conditions which occur among the several utilities in the industry with respect to the gas supply, its market and its price level, it is not the purpose of this discussion to attempt to indicate relative values of industrial and commercial gas loads in relation to other services. However, it is my belief that the development of commercial and industrial loads in many instances either already constitutes or presents an opportunity for a great sustaining force in an industry in which the domestic business has, in recent years, shown either a declining or barely more than a static condition. While we look for some revival of the domestic market, particularly through expansion of house-heating in the manufactured gas industry, the great outlook of the gas industry as a whole appears to be in the industrial and commercial field in which the ever expanding requirements for thermal applications can logically be supplied with gas.

Recovering Residual Gas

(Continued from page 59)

pressors, $4000 for piping, building an auxiliary machinery and $3500 for labor, teaming and other expense. Thus the total cost of installation would be approximately $15,000 or a little more than twice the cost of installing the rotary type of compressors. The cost of the engines and compressors themselves would be slightly more than the total cost of installing an equal capacity of rotary compressors.

The operating expense of the reciprocating compressor is slightly greater, because the services of one operator are required for a full day each day. The maintenance charges are considerably higher as shown by the figures for a representative actual installation as given in Table #3.

For this type of operation, the final depletion of the natural gas reserves of a small group of wells, the rotary compressor has a slight economic advantage due to its low first cost and low maintenance charges. However, its great advantage lies in the fact that the whole installation can be moved at the end of a one or two year period with only a small loss in invested capital.

Presented at the Spring Meeting of the Eastern District, A.P.I. Division of Production, Columbus, Ohio, April 13-14, 1944.

Metallizing. Catalog 42B, recently issued by Metallizing Engineering Co., Inc., 38-14 30th Street, Long Island City 1, N. Y., describes Metco Metallizing Guns, Wires, Surface Preparing Tools and other metallizing accessories in detail. In addition, it tells how sprayed metal coatings are saving critical materials and manpower in the production and maintenance of war-needed parts and equipment.

Southern Gas Assn. Meeting

The Southern Gas Association held its annual meeting and war conference at New Orleans, March 22-23. The meeting was attended by 400 members from 14 southern states.

Frank S. Kelly, Jr., Arkansas Louisiana Gas Co., Shreveport, La., was elected president, succeeding Frank C. Smith, Houston Natural Gas Co.

Other officers elected were Clayton L. Nairne, New Orleans Public Service, Inc., first vice-president; John H. Warden, Oklahoma Natural Gas Co., Tulsa, second vice-president, and L. I. Baxter, Arkansas Western Gas Co., Fayetteville, secretary-treasurer.

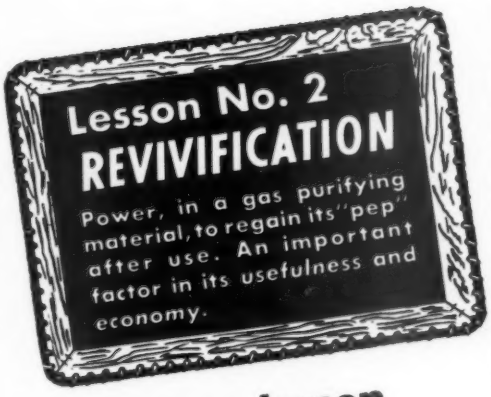
The meeting consisted of three general sessions and five sectional meetings. President Smith presided at the general sessions; Mr. Warden at the meeting of the Sales Section; Mr. Nairne at the meeting of the Operating Section; A. B. Banowsky, Houston, Tex., of United Gas Corp., presided at the Industrial and Commercial Section meeting; Oakah L. Jones, Tulsa, Okla., of Oklahoma Natural Gas Co., presided at the Accounting Section meeting and Cephalie Lewis, Atlanta, Ga., Atlanta Gas Light Co., presided at the home service section meeting.

Gas Cooking Stove Output Clarified

Simplified models of gas cooking stoves now on the market will be the only ones available for some time, Henry A. Dinegar, director of the durable goods and products branch of the Office of Civilian Requirements, said recently in clarifying the recent announcement that consideration is being given to the removal of restrictions on production of the stoves.

Although the advisability of permitting the resumption of production of standard model gas ranges is under consideration, no action has been taken, Mr. Dinegar explained.

Even if restrictions on standard models are removed, he added, it would be several months after the effective date of the order before such models could reach consumers because of the length of time manufacturers would need to obtain the necessary raw materials and component parts. The time lag between allocation of materials and actual production could well run into six months, he said.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It works with speed and does its work thoroughly because it is made specifically to accomplish maximum sulphur removal in minimum time, at minimum cost.

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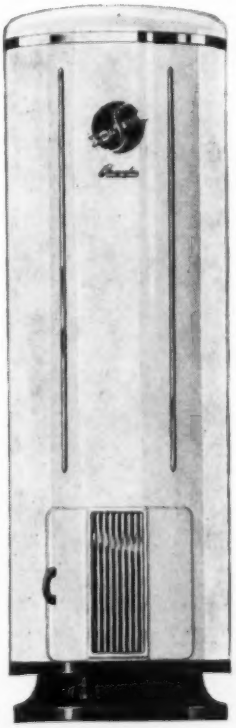

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